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VOL LXVI

19 JANUARY 1952

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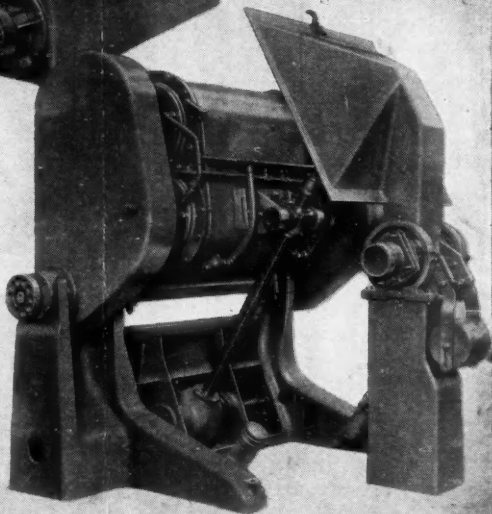
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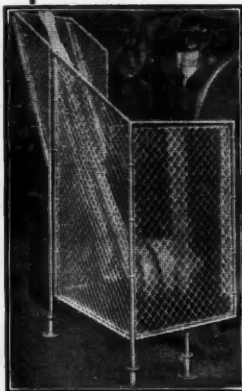
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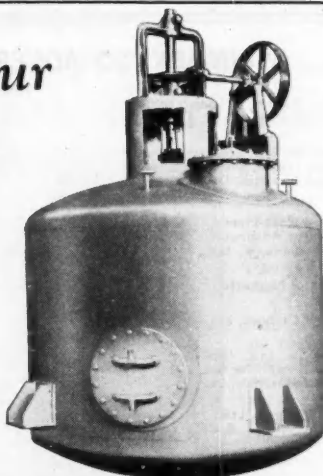
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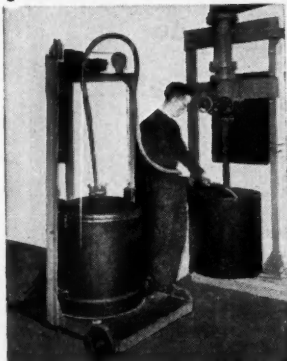
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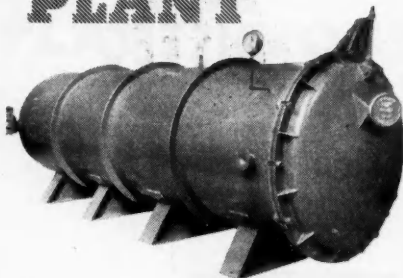
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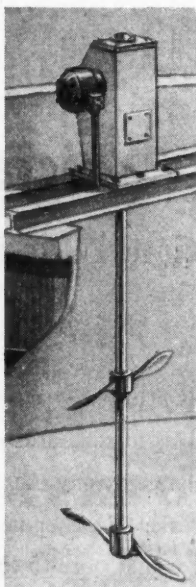


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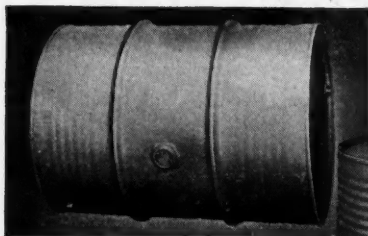
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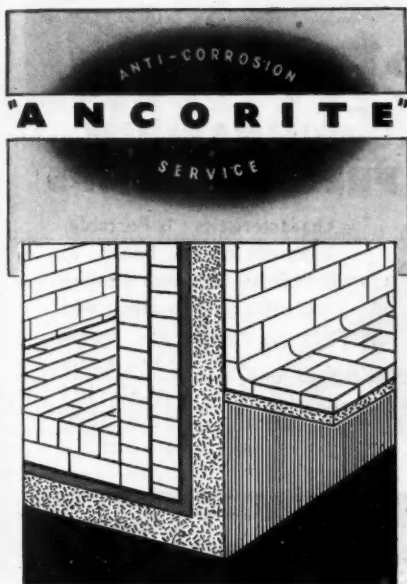
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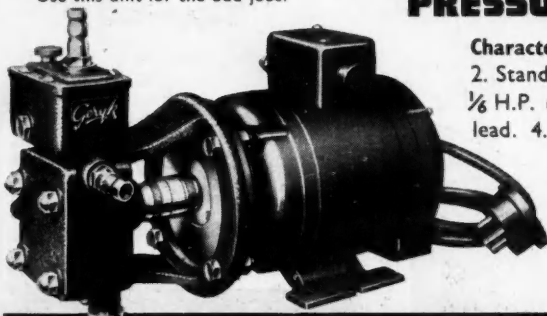
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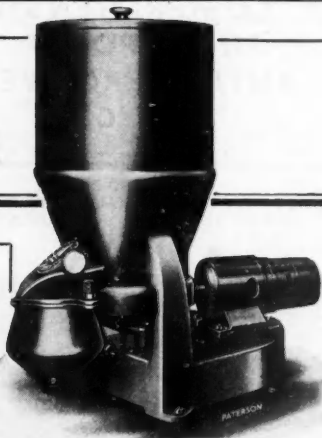


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Volume LXVI

19 January 1952

Number 1697

The 'Applied' Reports

WHEN last year we devoted these comments to the 1949 Annual Reports on the Progress of Applied Chemistry we foolishly suggested that with 928 pages this yearly publication had reached a fitting size and shape and that it would become over-formidable if it grew any bigger. The 1950 Reports have now appeared and we must confess to being proved wrong—the number of pages has risen to 992 but the book is still handleable; indeed, a change in the type of print used has given the new volume a less formidable appearance. It is well known to members of the Society of Chemical Industry that every effort has been made by the contributors, the section editors, and the Society's permanent editorial staff to achieve publication within one year of the actual year reviewed. Once again this target or date-line has just been missed. The magnitude of the task seems almost certain to involve as much delay as this each year. Last year the number of specialist writers rose from 50 to 61; for this latest issue that number has risen to 81. Far from being disappointingly late, publication by early 1952 represents a book-making achievement. The collecting together of all

this material, its editing and proof-checking, is a task that only those who have also served as midwives to the printed page can assess and understand.

One notable change is the adoption of the Harvard system for giving references. Whether this is in fact better than the old system of numbered references is still a matter of opinion. Visually the frequent interruption of the text by numbers may have been irritating to some; now instead the names of all workers whose contributions are mentioned must appear in the text and this can be equally irritating, especially when so many papers are today written by teams of workers. The Harvard system must lengthen the text of scientific reviews and its adoption must partly explain the increase in the number of pages needed this year. With the old system, too, references in the list followed their sequence of mention; now the list is alphabetical. This surely involves the reader in more work, a trivial increase perhaps but with solid matter of this kind the reader's task of utilisation is not in any case a light one. The main advantage of the Harvard system is probably its lower risk of error—the previous system must have

imposed a severe burden upon the editorial staff and the proof-readers, especially in sections where several hundred references were given. It needed only one undetected error in a single number for the system to break down.

The applied chemistry of food has returned with sections on fruits and vegetables, cereals, dairy products, meat and meat products, fish, whalemeat, and food freezing and refrigeration. A new section on explosives covers the years 1939-50; the national necessity for secrecy in this field has caused the absence of this section for so long. Even now only a limited amount of the progress made since 1939 has been free for review. Although the section on fats and fatty oils continues to embrace detergents, an extra section this year covers the important field of 'laundry chemicals.' The section on starch that had vanished in the 1949 volume has returned. Another new section, though making only a short initial bow, covers the use of enzymes in applied chemistry; a difficult field to cover without overlap with more general branches of biological chemistry, but the writer, Dr. G. M. Dyson, has strictly limited his territory to enzyme manufacture and assaying and to industrial uses in which the principal feature is the nature of the ferment. These are the main changes from 1949. They are all additive and it is to be hoped

that the general problem of paper and publishing will not bring back contractive or subtractive tendencies.

Perhaps no section has such relevant implication for these Reports and all our other contributions to the world's literature of science as that on 'Pulp and Paper.' Mr. S. R. H. Edge says (and it is of 1950 not 1951) 'the year under review has seen a continuation of a rise in price and an increasing shortage in the raw materials for paper-making . . . Great efforts have been made to increase the yield of pulp from a given amount of wood . . . A great deal has been done also to find other materials which can be used for paper-making and in perfecting the methods of manufacture . . . so that the maximum yield possible is always obtained. These important facts will come up again and again in the course of this Report.' The outlook for 1952 and after is at least as grim as that of 1950; the scarcity factor seems little abated and the price factor has become far more disturbing. The progress of all branches of science would seem to rest heavily upon the progress of those scientists who turn wood and other cellulosic materials into paper. Nevertheless, gloomy outlooks have not so far proved wholly right. The numbers of pages in these annual reports have steadily risen: 1947, 518 pages; 1948, 742; 1949, 928; 1950, 992. That, too, is progress.

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Notes & Comments

Competing with Uncle Sam

IN a Note last week the significant increases in our chemical exports to both America and Canada were referred to. There are signs that the American chemical industry is watching the position very closely. With German chemical production striding forward again, with Japan re-awakening, it is not only competition from Britain and Switzerland that the home producer in the United States has to face. The same competition is felt in other markets, particularly in South America. It is perhaps odd for students of Anglo-American Productivity Reports to come across this piece of commentary taken from a U.S. journal late in 1951: 'This drive of foreign producers is helped by their lower costs and dollar shortages.'

Two Disturbing Factors

TWO factors are disturbing the chemical industry in the United States. Since the spring of 1951 there has not only been an increase in chemical imports from Europe but there has been a change in their nature; imports are not mainly raw materials and intermediates—they are showing a trend towards finished or refined chemicals, e.g., drugs, dyestuffs, etc. The second is as yet potential—the encouraging effects of the Torquay tariff agreement; the reduction in tariffs will make it far more difficult for home producers in the United States to meet foreign competition on price. Another quotation from the same American journal is relevant: 'If hardship results, many domestic producers will do their best to restore the original tariffs.' It has never been a bad business practice to see ourselves as others see us; for 1952 the British chemical exporter can derive more hope than the American producer from these candid assessments. However, the U.S. industry is expecting its year-by-year expansion to continue; the requirements of the defence programme dwarf any inroads that imported chemicals may make. But the more distant future has a less certain rosiness. What

happens if the defence demand drops? Will European producers be well established in America's home market (because it is Europe's best dollar market)—and firmly entrenched in America's natural export markets? These are fears to be considered although their effect is not yet apparent.

Research and Finance

EXPENDITURE upon research is very difficult to assess as it is not easy to relate it to any particular factor, such as turnover, although the report of the Association of British Chemical Manufacturers in 1949 deduced that the industry as a whole expended a sum equal to or a little more than 2.5 per cent of turnover. In 1948 the British chemical industry expended £8,500,000 on research and development and this was expected to rise to £11,000,000 as soon as schemes for the expansion of research facilities could be completed. Some comment on this financial problem is made by Sir Harry Jephcott (managing director, Glaxo Laboratories, Ltd.), in an article 'How Much on Research?' in the current issue of *Research* (Vol. 5, No. 1). Sir Harry emphasises the need for the industrialist to have imagination and take risks, one of which must be to spend freely on research for future benefit. Present controls and limitations, however, provide little encouragement or opportunity to equip new ventures, and under these circumstances industry may well exhibit an increasing reluctance to embark upon long-term research projects. This may, as Sir Harry points out, prove beneficial. There can be few processes so efficient that there is not room for improvement and the effect of reducing long-term research may well focus attention upon investigations that do not require such heavy capital expenditure but may be brought to fruition by modifying current techniques. It is indeed by increased efficiency with little expenditure that industry can best aid the national economic problem.

Hydromechanics Research

Investigations at New Harlow Laboratory

A WIDE range of problems was investigated by the British Hydromechanics Research Association, Harlow, Essex, during the period October, 1950, to September, 1951, despite the difficulties of obtaining equipment or even simple engineering stores.

An increasing demand for special investigations on behalf of individual members was revealed in the association's fourth annual report published recently. One of the most interesting of these was the construction of a model circular spillway.

Study of the performance of centrifugal pumps was a long-term scheme and in this connection a transparent test rig, for the observation of flow in a centrifugal pump impeller, was under construction in the workshop. The 'casing' of this experimental pump was being constructed in glass and the impeller and suction pipe in clear 'Perspex' sheet. The drive is through a vertical shaft and arrangements have been made to measure the torque transmitted to the impeller.

Following the advice of the research committee on seals, packings and joints, the resources of the association in that field were devoted primarily to the study of seals for rotating shafts. In contrast to these experiments on actual seals a study was made of the fundamentals of friction and lubrication of seals, mainly with reference to rubber and similar materials.

Test Rig Construction

Work on the construction of the test rig for investigating the behaviour of self-acting valves progressed during the period under review. Manufacture of components was governed by the availability of machine tools and labour in the laboratory, but considerable help was given by members in supplying patterns and castings and in carrying out some of the machinery operations.

The 14,000 sq. ft. laboratory, completed early in the year, was officially opened by the president of the association, Sir John Anderson, on 24 May. It comprises a main laboratory about 120 by 72 ft., single-storey except for one end, where an encircling gallery gives additional height for pump suction lift tests, etc. A pump and various tanks are installed, but the layout has been deliberately kept as open as possible to faci-

tate temporary rigs. A machine shop, generator room and oil laboratory are provided. A library, drawing office, dark room and instrument laboratory are included in the adjoining two-storey office block.

Most of the eligible companies in the pump industry now belong to the association, membership of which is comprised of 33 manufacturing and seven user members, 17 consultants and 32 research workers.

A reserve had been accumulated of about £15,000, and although it was thought advisable to keep some working capital to allow for delay in obtaining payment of subscriptions and Government grant, a proportion of this amount was spent on major equipment for the laboratory.

Owing to the work involved in moving into and equipping the new laboratory no conference was held, but it is hoped one will be organised during 1952.

Gaseous Fuels Demand

INCREASED domestic and industrial demand for gaseous fuels has spurred interest in substitutes for natural gas in America, according to a paper read to the American Institute of Chemical Engineers recently. The synthesis of methane from $\text{CO} + \text{H}_2$ (a process like the Fischer-Tropsch) is considered as one answer, but a preliminary engineering design has been developed in order to study the cost of producing high-calorie pipeline gas from coal. The investment in such a plant capable of producing 250,000,000 s.c.f.d. has been estimated to be \$150 million, exclusive of mining and coal preparation. A non-caking type of coal is fed to Lurgi gas generators to be reacted with oxygen and superheated steam. The gas produced in this step contains substantial quantities of methane. This gas is carefully desulphurised and the CO_2 is removed. The purified gas is then methanised over a nickel catalyst. Removal of CO_2 formed during methanisation leaves high-calorie gas, dehydrated, and ready for pipeline distribution.

Estimated investment includes cost of producing oxygen and superheated steam used in process. All utilities are produced within the plant. River water is assumed available for cooling. Wastes are disposed of with due regard to public welfare. Labour rates and constructional costs are based upon late summer 1951 prices.

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MIDLANDS ANALYTICAL METHODS DISCUSSION GROUP

New Methods in Electrometric Analysis

THE speakers at a recent meeting of the Midlands Analytical Methods Discussion Group held in Birmingham were Mr. J. E. B. Randles, of the Chemistry Department, University of Birmingham, and Messrs. G. W. C. Milner and R. N. Whittem, of AERE.

The discussion was opened by Mr. Randles, who chose as his subject 'Some Advances in Polarography'. Within recent years (he said), there have been many developments both in the theory and practice of polarography. Thus, a number of papers has appeared on the fundamental theory of the polarographic diffusion current. Both the variation of current with time during the lifetime of a drop and the mean value of the current are concerned. The latter may be considered first.

Evidence has accumulated, since the pioneer work of Lingane and Loveridge (1946), that the diffusion current 'constant'

$$I = i_d / \text{cm}^{2/3} \tau^{1/6}$$

(where i_d = mean diffusion current, c = concentration of depolariser, m = rate of mercury through the capillary, and τ = drop time) is not constant when m and τ are varied. In other words, the Ilkovic equation (Ilkovic, 1934, 1938) is not strictly true.

Stirring Effects Cause Rise

The variation of I consists of a fairly rapid rise with increasing drop rate when τ is less than about 1 second, and a slower rise with decreasing drop rate for longer drop times (up to 7 seconds or so). The former rise is almost certainly due to stirring effects caused by the rapid flow of mercury from the orifice of the capillary, and can be inhibited to some extent by the usual maximum suppressors (Krkowa, 1947, Buckley and Taylor, 1945). The rise with increasing drop time is almost certainly due to the fact that the diffusion layer surrounding the mercury drop is a spherical shell, whereas the original derivations of the Ilkovic equation had either explicitly (Ilkovic *loc. cit.*) or by approximations (Macgillavry and Rideal, 1937) treated it as planar. The effect of taking the curvature of the diffusion layer into account has been shown (Lingane and Loveridge, 1950, Strehlow and Von Stackelberg, 1950, Kambara and Tachi,

1951) to appear as an additional term in the Ilkovic equation, so that, instead of the original equation:

$$i_d = 607 \text{ nD}^{1/2} \text{cm}^{2/3} \tau^{1/6}$$

we have

$$i_d = 607 \text{ nD}^{1/2} \text{cm}^{2/3} \tau^{1/6} \left\{ 1 + A \frac{\text{D}^{1/2} \tau^{1/6}}{m^{1/2}} \right\}$$

where the numerical factor A is 39 according to Lingane and Loveridge, and Kambara and Tachi, and 17 according to Strehlow and Von Stackelberg. Sufficient data has not yet been accumulated to show conclusively which factor accords better with experiment, and both derivations involve some approximations. The variation of the additional factor in the bracket corresponding to the normal range of $\tau^{1/6}/m^{1/2}$ (say 0.7-1.2 sec.^{1/2} mg.^{-1/2}) is about 0.06, giving a variation of the 'constant' I of ± 3 per cent. Thus, in work requiring higher accuracy than this, the variation of I must be taken into account.

Growth Equation

The growth of the diffusion current during the lifetime of a mercury drop is, according to the Ilkovic equation, given by

$$I_t \propto t^{1/6}$$

where I_t is the current at time t from the start of drop growth. Oscillographic studies (Mackenzie, 1948, Taylor, Smith and Cooter, 1949) have shown that this relationship is not obeyed, particularly in the early stages of drop growth. If the $t^{1/6}$ law curve, obeyed by the current in the later stages of drop growth, is continued back to $t = 0$, it is found that the actual current falls much below this during the first few tenths of a second. This cannot be satisfactorily explained on the basis of the deviations from the Ilkovic equation discussed above. It would be the case where the electrode reaction is slow (cf. Delahay, 1951), but the experimental work of Taylor, Smith and Cooter was carried out with the cadmium ion reduction potential at several tenths of a volt negative to its half-wave potential, and such an explanation would not be valid here. It appears more likely that it is due, as suggested by Airey and Smales (1950), to

a residue of the partly exhausted solution from the diffusion layer of each drop being left, after drop-fall, near the capillary orifice. The new drop thus starts life in a solution partly exhausted of depolariser, and, therefore, the current is less than it should be.

Such an effect will, in itself, cause deviations from the Ilkovic equation, or from any equation based on the assumption that each drop starts growth in entirely fresh solution.

On the whole, the most interesting advances in polarographic techniques in recent years have been those involving the use of a much higher rate of change of potential of the dropping electrode than that used in classical polarography.

Linear Potential Sweep Variable

One group of such techniques employs a linear potential sweep covering a range of potential similar to that used in classical polarography. The sweep may be relatively slow, occupying a period of one second or so during the life of a drop (Randles, 1948, Snowden and Page, 1950), or very rapid, having a frequency of 20 up to 100 or more per second (Delahay, 1949-51). The current-voltage curve, resulting from the changing potential of the dropping electrode, is presented on the screen of a cathode-ray tube, and by various methods the magnitude of the current due to each reduction process may be found and used as a measure of concentration of the polariser.

A more radical departure from classical polarography is provided by alternating current polarography which is at present in an embryonic stage. The method is based on the fact that, if a sinusoidal alternating potential of small amplitude is superimposed on the steady, or very slowly changing, potential of the dropping electrode, a corresponding alternating current will flow in it.

This current is the sum of two components, one due to the double layer capacity of the mercury-solution interface and the other due to any depolarising reaction which may be occurring at the electrode. This latter current is only significant when the potential of the dropping electrode is at or near the half-wave potential of a depolarising reaction, and falls almost to zero in the regions where a normal polarogram runs

parallel to the voltage axis. An important difference between the two components of the current is that the part due to the double layer capacity, which may be described as the 'condenser current', is always almost 90° in advance of the alternating potential of the electrode, while the reaction current varies from only 45° to 0° in advance (depending on the kinetics of the electrode reaction and the frequency of the alternating potential). A phase-selective amplifier can therefore be used to reject the unwanted condenser current, and to amplify the reaction current or part of it. A very ingenious method of doing this, without using any complicated electronic equipment, has been devised by Jessop. (1948). A Carpenter relay, operated at the same frequency as the alternating potential applied to the dropping electrode, but with adjustable phase, serves as a phase-selective rectifier. The rectified and smoothed current passes through a D.C. galvanometer. The phase of the relay is adjusted so as to minimise response due to condenser current alone.

Eliminates Reduction Current Interference

When the electrode is immersed in a solution containing depolarisers, and the mean potential of the electrode altered slowly as in classical polarography, a current response is obtained in the form of a peak occurring at each half-wave potential, the height of each peak depending, *inter alia*, on the concentration of the corresponding depolariser. Between peaks the current falls almost to zero. The method thus has the advantage of eliminating to a considerable extent the interference which a large reduction current, starting at a fairly positive potential, always imposes, in classical polarography, on the measurement of small currents occurring at more negative potentials. Nevertheless, there is one characteristic of the alternating reaction current which will probably render alternating current polarography unsuitable for general use, although for specific purposes it may have great advantages. This characteristic is the dependence of the current at all usable frequencies, not only on the rate of diffusion of the polariser, but also on its rate of reaction at the electrode surface (Randles, 1947). The latter is extremely sensitive to the presence of surface-active materials on the mercury surface. Even when surface-active substances are not deliberately added

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to prevent the 'stirring' of the mercury surface which is the cause of 'polarographic maxima', they are present in most solutions as impurities. Very rigorous control, or elimination, of such substances would be necessary to ensure a reliable proportionality between current response, and concentration of depolariser, in general.

Messrs. Milner and Whitem then took up the discussion, and presented an account of some recent developments in controlled potential analyses. When a single metal is present in solution, the usual method of its chemical analysis by electrodeposition is to apply a voltage to the cathode and anode, and to allow the electrolysis to continue with little or no further attention. This method is known as constant current electrolysis, and can on occasion be used to separate one metal from another, when the one is below, and the other above, hydrogen in the potential series.

The electrolysis is not possible, however, if the second metal is just above the other in the potential series, as it generally begins to deposit before the first metal has been completely removed. A separation of the two metals may be effected by use of a controlled cathode potential electrolysis, where the potential of the cathode is measured (using an auxiliary reference electrode) and during the electrodeposition is limited to a specific value by decreasing the voltage applied to the cathode and anode.

Control Working Electrode Potential

It is, of course, the potential of the electrode which determines whether an electrode reaction will take place. Therefore, if we can control the potential of the working electrode, we can attain a high degree of selectivity with respect to the reactions taking place at the electrode.

The pioneer workers in the application of controlled potential analysis to the electrogravimetric determination of metals were Sand (1907, 1909) and Fischer (1907). The earlier apparatus used was manually operated, and there is no doubt that the use of manual circuits was responsible to a large extent for the general lack of interest shown in controlled potential analysis. However, several instruments have been developed during the last decade or so which automatically control the potential of a working electrode at a required value. The first of these automatic instruments due to Hickling

(1942), and to Caldwell, Parker and Diehl (1944), controlled the potential in one direction only. Lingane (1945) devised an instrument which gave control in both directions, *i.e.*, the cathode potential was maintained at a required value with no positive or negative drift during the electrolysis. Lingane's apparatus has proved of great value in the analysis of copper-base alloys. Copper and antimony are removed simultaneously from a hydrochloric acid solution of the alloy by maintaining the cathode at -0.36 v. against S.C.E., the lead and tin in the solution then being determined polarographically. In a similar way, copper, antimony, tin and lead are removed by electrolysis at -0.70 v. against S.C.E., and nickel and zinc remaining determined polarographically.

Copper Removed

The value of this technique lies in the fact that copper, which interferes in most polarographic determinations when present in large amounts, is completely removed from solution without introducing additional chemicals. Lingane, however, only used this technique for the removal of copper and not for its determination. Milner and Whitem (1952, in press) have developed an easily constructed apparatus for the analysis of copper-base alloys by controlled potential electrolysis which includes the determination of the copper. The apparatus is inexpensive and robust, and has provided satisfactorily results over several months. It has the following characteristics:

- (1) Sensitivity to voltage changes of ± 5 mv. over the range $+2$ to -2 v., thus enabling the cathode to be maintained within ± 5 mv. of a predetermined value.
- (2) Stability of ± 5 mv. for at least one hour.
- (3) An input resistance of 10 megohms to limit the current passing through the reference electrode. This minimises polarisation and resistive effects.
- (4) A rapid response enabling voltage changes to be corrected within a few seconds.
- (5) Ease of operation.
- (6) Construction from easily available components.

It is not possible to give details of the apparatus here, but a brief outline of some of its features may be given together with some of its applications to the analysis of copper-base alloys. Incorporated in the

instrument are some of the principles of the Diehl single-direction control apparatus. The cathode reference cell potential is opposed by a precision potentiometer, so that, if the former potential alters during an electrolysis, the difference between the two potentials is amplified, the output of the amplifier operating two relays which control a reversible motor driving the variable arm of the potentiometer supplying the current for the electrolysis. In this way the electrolysis current is automatically adjusted to correct the difference between the two potentials. A slight positive or negative difference between the cathode reference cell potential and that of the precision potentiometer actuates the control circuit to increase or decrease the electrolysis current, thereby eliminating this difference.

Copper Deposit Patchy

A preliminary investigation showed that copper gave a patchy deposit from solutions which were 1 to 1.5M with respect to hydrochloric acid, in agreement with the findings of Lingane (1946), although better deposits were obtained when the concentration of hydrochloric acid was just sufficient to prevent the hydrolysis of tin (< 0.5 M). The main snag was that some deposits did not adhere well, being easily removed in the washing process subsequent to the electrolysis. Again, the deposits were often badly discoloured. The observation of Osborne (1949), that when gelatine was present in solutions of cadmium salts being electrolysed, a hard clean deposit was obtained, appeared to be of interest. When a small amount of gelatine was, therefore, added to the hydrochloric acid solution of the copper base alloy, and the solution electrolysed at a controlled cathode potential of -0.36 v. against S.C.E., good adherent copper deposits were obtained.

If antimony is present in the alloy, it deposits with the copper at this potential. Hence, for accurate copper results on alloys containing more than trace amounts of antimony, a correction must be applied.

After removal of the copper, attempts were made to determine the lead plus tin directly by continuing the electrolysis with a copper-coated, platinum cathode at -0.7 v. against S.C.E.

However, the deposition of both elements

was very slow and incomplete, but by increasing the concentration of hydrochloric acid, a great improvement was effected. When the lead-tin deposit was washed after the completion of the electrolysis, the metals tended to redissolve, but this difficulty was overcome by using the method of Lindsey (1950), who made the solution ammoniacal before washing.

After determination of the percentage of lead plus tin from the increase in weight of the cathode, the deposit was dissolved in nitric acid and the solution evaporated to low bulk to precipitate the tin in the usual way as metastannic acid. The lead in the filtrate was determined by deposition from nearly boiling solution as the dioxide on a small platinum gauze anode. The use of an empirical factor (Sand, 1940) gave the percentage of lead in the alloy, the percentage of tin being obtained by difference.

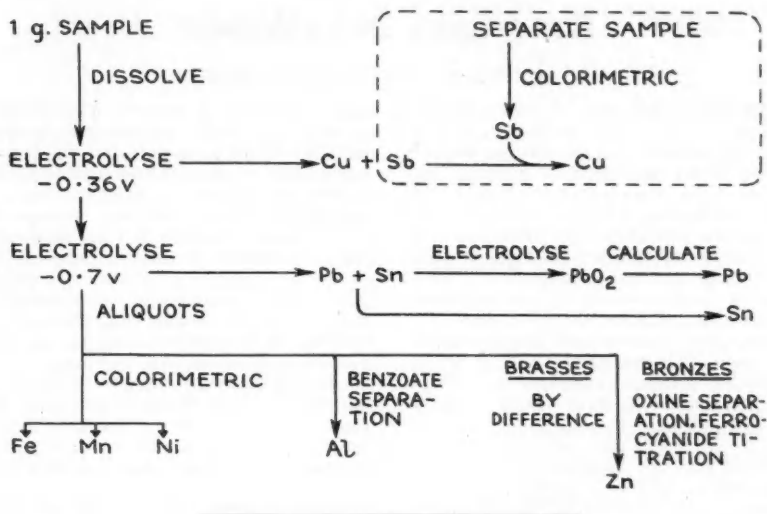
The solution remaining (that is, after removal of copper, lead, tin) was reacidified with hydrochloric acid, diluted, and suitable aliquots taken for the determination of the other alloying constituents (iron, manganese, nickel, zinc and aluminium). Absorptometric methods were used for the determination of iron, manganese and nickel. Zinc in tin bronzes was determined after its selective precipitation with 8-hydroxyquinoline (with magnesium as carrier) by titration with standard potassium ferrocyanide using naphthidine (Belcher and Nutten, 1951) as indicator. Zinc in brasses, however, was estimated by difference after determining all the other alloying constituents. Aluminium in brasses was determined titrimetrically after selective precipitation with ammonium benzoate.

One-Gram Sample Used

By combining the above techniques, all the usually occurring elements in copper-base alloys were determined using a 1 g. sample.

The scheme adopted may be represented diagrammatically as on page 127.

Results obtained on Standard alloys agreed closely with accepted figures. The method is of special value for the accurate analysis of copper-base alloys which are in limited supply. Of importance also is the comparative rapidity with which an analysis may be effected.



Fumigation Regulations

NEW regulations concerning the fumigation of buildings and ships, which were made last October by the Secretary of State for Home Affairs, come into operation at the beginning of next month.

The Hydrogen Cyanide (Fumigation of Buildings) Regulations, 1951, make detailed provision regarding the precautions to be taken in carrying out the fumigation of buildings and replace the Hydrogen Cyanide (Fumigation of Buildings) Regulations, 1938.

Principal additions are that the operator is required to sign and give to the occupier, before beginning a fumigation, a statement relating to the requirements of the Regulations as to the exclusion of unauthorised persons and other precautionary measures, and, after the fumigation is completed, a certificate that all the requirements as to ventilation and other safety measures have been complied with.

Precautions to be taken in carrying out the fumigation of ships are set out in the Hydrogen Cyanide (Fumigation of Ships) Regulations, 1951. These include provisions regarding the giving of notice to certain persons, including the medical officer of health, of a forthcoming fumigation, and they require the members of a fumigation

staff to be adequately trained and equipped with protective apparatus.

No unauthorised person may enter the area of risk until it has been established that no danger remains, but provision is made, with the necessary safeguards, for the entry of the crew for starting ventilating fans where necessary, or of other authorised persons to remove certain articles.

Copies of the Regulations (*S.I.* 1951 No. 1759 and *S.I.* 1951 No. 1760) can be purchased from HMSO, price 6d. and 9d. net, respectively (7½d. and 10½d. post paid).

Aslib Conference

A FULL-DAY conference of the northern branch of the Association of Special Libraries and Information Bureaux will be held in Sheffield, 27 March.

At the morning session G. H. Davison (United Steel Companies, Ltd.), J. R. Smith (Sheffield City Libraries), and E. B. Smith (Safety in Mines Research Board), will participate in a symposium on the 'Working of a Public Technical Library', a 'Government Library' and an 'Industrial Library'. In the afternoon P. A. Nash (information officer, MacTaggart & Evans, Ltd., Sonde Place Research Institute, Dorking), will give a paper on 'Technical Information Services'.

American Newsletter

(From Our Own Correspondent)

INCREASING quantities of coal chemicals are being made available in the U.S.A. as a result of the huge post-war expansion programme of the iron and steel industry. As part of this development a net increase of more than 6,000,000 tons is expected to be made in the annual capacity of coke ovens. This in turn will provide large amounts of raw materials for the manufacture of a wide range of products from sulphur drugs and vitamin pills to DDT. A ton of coal in a modern coke oven will yield in coal chemicals about eight gallons of tar; 20 lb. of ammonium sulphate; 6,000 cu. ft. of surplus gas; and about three gallons of light oils. Ammonia is also recovered. According to a preliminary estimate by the American Iron and Steel Institute, the total production of coke by all processes in 1951 reached a record level of approximately 79,000,000 tons, or about 9.6 per cent more than in 1950.

EQUIPMENT for a complete chlorine plant to be erected at its phosphate division's works, Anniston, Alabama, has been purchased by the Monsanto Chemical Company from Dr. Ing. Oronzio De Nora, of Milan, Italy, manufacturers of electrochemical plant and developer of the De Nora mercury cell. J. L. Christian, vice-president and general manager of Monsanto's phosphate division, said that this step had been taken as a means of alleviating as quickly as possible the present critical shortage of chlorine in the U.S.A. The new addition, which will have a capacity of 25 tons daily, is expected to be in operation by the middle of this year. Since 1948 Monsanto has had an agreement with the Italian company to use and sell the De Nora cell in the U.S.A.

CONTRACT for the construction of a large coal conversion pilot plant, to be completed during the latter part of this year, has been awarded by the Pittsburgh Consolidation Coal Company, to the chemicals division of the Blaw-Knox Company. Operation of the pilot plant is expected to provide answers to two major questions, namely, cost and design data for a commercial plant, and the production of sufficient quantities of liquids to permit commercial evaluation of the

many chemicals and special carbons obtained by the process. The carbonisation process itself is claimed to have been proved by a long period of research and operation of a smaller pilot plant. When partially converting coal by the new low temperature carbonisation process, each ton of coal produces seven-tenths of a ton of high-B.Th.U. solid fuel called 'char', about 37 to 40 gallons of tar liquid and some gas. The char product serves as a high-grade boiler fuel, and the liquid, when refined by processes developed by the company, yields low-boiling tar acids, creosotes or feedstock for making carbon black, and electrode carbons. The tar acids—phenols, cresols, and cresylic acids—are used as chemicals and as intermediates by the plastics industry.

A NEW beryllium oxide plant is to be brought into operation at Resende, Rio de Janeiro, in March. The plant, which will cost \$275,000, is being constructed by Proberil, S.A., a new firm jointly financed by Brazilian and American interests, and will have a capacity of 90 tons of beryllium oxide a year. Raw materials for the new plant will come from the largest known beryllium mine in Brazil, located in the state of Minas Gerais. Sulphuric acid used in the process will be made at Barra Mansa in Minas. Brazil is a principal producer of beryllium, at present a relatively scarce metal. Brazilian beryllium ore runs about 11 to 14 per cent metal, while the world market standard for the ore is about 10 per cent. Other beryllium deposits are found in Brazil in the states of Bahia, Rio Grande do Norte and Paraíba.

ALTHOUGH too early to forecast future results, it has been found in America that aureomycin shows activity against pre-cancerous lesions. Lederle Laboratories, who are making the investigations, say that this points the way to a possible pre-cancer prophylaxis. Another disease in the news is poliomyelitis (infantile paralysis). A new vaccine is said to protect monkeys against some strains of the virus. However, many strains of the virus cause the disease in humans, and to be effective any vaccine must be effective against all of them.

South Africa's Oil-from-Coal Project

Foundations for Future Chemical Industry

PROSPECTS of a future chemical industry for South Africa based on petroleum materials were foreseen by Mr. P. E. Rousseau, managing director of the South African Coal, Oil and Gas Corporation, in an address given recently to the Junior Chamber of Commerce, Johannesburg, in which he outlined the progress of the Union's vast oil-from-coal project.

Sasol, as the enterprise is known, was not the result of an idea which had occurred to a group of people about eighteen months ago, but was in fact, the natural development of a practical vision which had excited the imagination of several well-informed groups in South Africa in the course of the last 30 years.

Interest in production of oil from coal really began in 1935 when the South African Torbanite Mining & Refining Co. was established under the aegis of the Anglo-Transvaal Consolidated Investment Company, which in the same year obtained the South African rights to the Fischer-Tropsch process. Further development was, however, delayed, until after the last war.

Interim Committee Formed

As a result of negotiations between Anglovaal and the Government, an interim committee was formed in May, 1950, to investigate the state of development of the technical processes overseas, and to report on the desirability of establishing an oil from coal industry in South Africa, as well as on the way in which such an industry should be financed and organised.

An arrangement was made with the Government whereby the Anglovaal work and rights were taken over and the South African Coal, Oil and Gas Corporation, Ltd., was established in September, 1950.

Technical considerations of Sasol's first project were then considered by Mr. Rousseau, whose speech was recorded in two issues of *The South African Mining and Engineering Journal* (62, 207-211, and 255-259).

The process to be employed, and found most suitable for South African low-grade coals, was a combination of the American and German developments from the original Fischer-Tropsch method. The project

would be divided into three major departments.

First, a coal mine, 1½ miles from the works, which would supply coal at the rate of about 7,000 tons daily. The fine coal would go into the plant's own power station which would consume about 1,800 tons a day. This was necessary to maintain a balance between the processing and steam power.

The next major department was the oxygen plant. Six Linde oxygen manufacturing units would process 7,500 tons of air daily and produce 1,500 tons of oxygen, mainly for the gasification plant.

Gasification Coal Consumption

Finally, the gasification section would consume some 3,200 tons of coal a day. This coal would be gasified by passing through oxygen from the oxygen plant, together with a portion of the steam from the power station. Nine Lurgi pressure gasification units would be employed. After purification, this gas stream would be split and taken through the M. W. Kellogg circulating catalyst unit and the Rurchemie-Lurgi fixed-bed catalyst synthesis plant.

Sasol's main duty was to produce petrol and diesel oil from coal but its importance as an industrial raw material producer over the next 10 years must be borne in mind. As often happens in chemical industries, it was hard to distinguish which was more vital, the main or the by-product.

The first series of by-products to be produced would be those coming from the coal gasification plant. These by-products were, therefore, not by-products of petrol production, but by-products from the distillation of coal. The amount of coal gasified was so large that the ammonia liquor condensed from the gasification process would contain ammonia equivalent to 25 tons per day or 9,000 tons a year of ammonia gas. In terms of nitrogen, this was two-thirds of South Africa's 1950 nitrogen fertiliser imports and about half of the anticipated 1951 imports.

Gasification would also produce as a by-product some 3,000,000 Imperial gallons annually of a low-temperature tar. From the crude ammonia liquor and this tar, there

could be produced some 10,000 tons of tar acids a year. It was doubtful whether it would be necessary to extract all these tar acids, but it would certainly be essential to produce some 6,000 tons or 1,200,000 Imperial gallons of tar acids a year.

There was not a very widespread use for such tar acids in South Africa at present, but tar acids were in such short supply overseas (mainly for plastics and synthetic fibres) that big works were being built to produce them synthetically.

Products made in the process of petrol synthesis would include ethyl-alcohol, propyl and butyl alcohols, and methanol, acetone and acetaldehyde.

Production of Paraffin Waxes

As one of its main products the company would produce about 14,000 tons of paraffin waxes of various types. Approximately half this quantity would be of micro-crystalline type, for which there was a good overseas market.

In 1925 one-tenth of one per cent of aliphatic organic chemicals were made from petroleum sources. By 1945 the figure had risen to 50 per cent and four years later it had reached 80 per cent. In the U.S.A. alone investment in the petroleum chemical industry in 1950 amounted to £350,000,000.

This new line of industry was opened up to South Africa by the existence of Sasol. By its conversion of coal all the raw materials normally obtained from the oil-processing industry would be available and in a purer form.

It was interesting to note the importance of petroleum chemicals in the future industrial picture of the world, and, therefore, also in the future of South Africa.

These chemicals from petroleum had started to replace natural materials which were in short supply and would probably be so for years to come. One of these materials was rubber. Synthetic rubber production in 1945 was 100,000 tons a year, and with the re-start of synthetic rubber production in the U.S.A. and in Germany, this production should be increasing and relieving the acute shortage which had been evident in the rubber market.

A second item in short supply was textile fibre. The newer synthetic fibres, such as 'Orlon' and 'Terylene', were made from raw materials obtained in the petroleum industry.

Production of plastics was another class

of material which had made rapid progress in the last few years.

Petroleum chemicals were also starting to release edible raw materials previously used for chemical production. This referred particularly to sugars and starches which were fermented to form alcohol, acetone, and other industrial solvents.

Detergents, made very largely from petroleum raw materials, were now relieving to a large extent the quantity of edible fat used in the soap industry. Glycerine, a by-product from the manufacture of soap from natural fats and which had been in short supply, was now being successfully made from petroleum gases at Houston, Texas.

Finally, the possibility of Sasol eventually being able to produce a supply of fuel gas would be of great value to the metal industries in South Africa.

It was obvious, therefore, that Sasol was an important extension to the Union's industrial structure, linking as it did the chemical and metallurgical industries and making possible the development of a synthetic organic chemical industry.

New CIL Chemical Project

CANADA'S first plant for the manufacture of polythene is to be built in Edmonton, Alberta, it is announced by Canadian Industries Limited. Construction is scheduled to begin next spring with production to start late in 1953. Cost is estimated at \$13,000,000.

The plant, to be erected on part of a recently purchased 300-acre site, will be the second CIL manufacturing unit in Alberta. A commercial explosives works is under construction near Calgary and is scheduled to start production by next spring.

More than 200 persons will be employed at the polythene plant which will require about 10,000,000 cubic feet of natural gas, 8,000,000 gallons of water and 35,000 kilowatt-hours of electricity a day. The manager will be John D. Wright, at present in charge of CIL's Windsor, Ontario, chemicals plant.

This is the second major chemicals project announced by CIL in the last six months. The other was a nylon raw materials plant at Maitland, Ont. Both projects will make Canada self-sufficient in vital and scarce materials hitherto imported. Initial production will be about 6,000 tons of polythene flake a year.

Isolation of Glutamine from Beetroot

Displacement Chromatography as a General Method

A GENERAL method for the isolation of amino-acids and organic bases by displacement chromatography, using synthetic ion-exchange resins, has been described by Partridge and his co-workers.^{1,2} Exploratory experiments subsequently described by Westall³ have shown that asparagine could be separated from glutamine and that glutamine formed a mixed band with alanine. Alanine, however, is readily separated from glutamine by fractional crystallisation.

An extract was prepared from freshly pulled beetroots, complete with leaves and rootlets. In order to protect the bed of resin from contamination with denatured protein it was advisable to remove as much protein as possible from the beet extract before passing it through the column. Treatment with basic lead acetate precipitated the protein together with the red colouring substance and yielded, after filtration, a clear orange-coloured solution. Even if the minimum amount of basic lead acetate was used to ensure complete precipitation, some lead remained in solution and was retained on the cation-exchange column. Since a column contaminated with Pb^{++} cannot be fully regenerated with dilute HCl owing to the formation of sparingly soluble lead chloride, the cleared extract was passed first through a small subsidiary column containing sufficient Zeo-Karb 215 resin to retain all the lead. Since the Pb^{++} was very strongly retained by the resin it remained at the top of the column and was not displaced by the subsequent passage of the aqueous ammonia used to displace the organic cations. After completing the experiment, the subsidiary column was detached and regenerated separately with dilute nitric acid.

Coupled Columns System

The system of coupled columns used in the experiment has been described by Partridge.² The column was made up of three sections placed side by side and connected in series with narrow glass tubing. The first section (diam. 3 in., height 30 in.) contained 1,100 g. (dry weight) of Zeo-Karb 215 (60-80 mesh/in.); the second section (diam. 2 in., height 20 in.) contained 330 g. resin; and the third section (diam. 1.5 in.,

height 15 in.) contained 138 g. resin. The subsidiary column (diam. 2 in., height 12 in.) contained 200 g. resin. The filtrate, diluted with an equal volume of water, was allowed to flow through the columns at a rate not exceeding 1.5 l./hr. The effluent solution, which contained free acids, sugars and other substances not reacting with the resin, was allowed to run to waste. When the total volume of extract (36 litres) had been applied to the columns, a further 5 litres of distilled water was run on to displace the extract remaining in the columns.

Column Developed

The column was developed by displacement with 0.17 N ammonia. The effluent was allowed to flow through a small conductivity cell and the resistance was measured on a 'Mullard' bridge energised by a 1,000-cycle oscillator. A sudden decrease in the resistance readings marked the break-through of aspartic acid, the first amino-acid to appear in the effluent. At this point, the outlet tube from the column system was connected to an automatic fraction collector, designed to deliver 250 ml. to each of 60 bottles. Fifty-eight bottles were filled and the amino-acid composition of each successive fraction was determined by introducing a drop from each bottle at 2 cm. intervals along the base-line of a paper chromatogram. Two large sheets of No. 1 Whatman filter paper were required and these were irrigated with phenol-1 per cent NH_3 in large tanks. A duplicate set was run in butanol-acetic acid mixture. After drying, the sheets were developed with ninhydrin solution in the usual way.

Fractions 1-10 contained aspartic acid, glutamic acid, serine, threonine, asparagine and a small quantity of glutamine and alanine. Fractions 11-16 contained a large amount of glutamine, together with smaller quantities of glutamic acid and alanine. Fractions 17-34 contained glutamine and alanine only. Fractions 35-48 contained a large amount of betaine, together with smaller quantities of glutamine, alanine and valine. Fractions 49-58 contained small amounts of valine, cystine, phenylalanine, histidine, lysine and β -alanine, together with

larger amounts of the isomeric leucines and α -aminobutyric acid.

Fractions (17-34) were bulked (4.5 litres). The amber solution was shaken with 12 g. charcoal for 10 min. The colourless filtrate was evaporated, under reduced pressure, at a temperature not exceeding 40°C., to 200 ml. Glutamine crystallised out after the gradual addition of two volumes of ethanol. A yield of 44.5 g. was obtained and two further crops, 7 g. in all, containing appreciable amounts of alanine, were set aside. The main group was recrystallised, using a similar procedure. Yield 36.0 g.

The fractions (11-16) were bulked (1.5 litres), treated with charcoal, filtered and evaporated to 70 ml. A yield of 14.8 g. was obtained from 70 per cent aqueous ethanol, which contained glutamine together with traces of alanine and also an appreciable quantity of glutamic acid. This crop was redissolved in water and passed through an anion-exchange column containing 30 g. of De-Acidite B. Glutamic acid was retained on the resin while glutamine and alanine passed through in the effluent. This solution was combined with the mother liquor from the recrystallisation of the glutamine obtained from the fractions (17-34). A further crop of glutamine was obtained from 70 per cent aqueous ethanol. Yield 14.0 g.

Filtrate Evaporated

Fractions 35-48 were combined (3.5 litres) and, after treatment with charcoal, the filtrate was evaporated under reduced pressure to 100 ml. Three volumes of ethanol were added and a white crystalline product (2.8 g.), which proved to be a mixture of glutamine and alanine, was removed. Ether was added gradually, with stirring, to the mother liquor until the mixture became slightly cloudy. Large colourless crystals separated on standing at 0°C. Yield 20.6 g. Two further crops were obtained under similar conditions, giving a total yield of 29.9 g. This substance, when run on paper chromatograms, gave R_F values identical with those of betaine in phenol-1 per cent NH_3 and in butanol-acetic acid mixture. Further, both substances gave the same brown-coloured spots when sprayed with Brandt's iodine reagent. The crystalline substance contained 1 mol. H_2O .

Fractions (52-54) (750 ml.) were further fractionated by passage through a small-

scale Zeo-Karb column containing 50 g. resin. The amino-acids were displaced by developing the column with 0.15N aqueous ammonia and 25 fractions were collected. An illustration of the paper chromatogram obtained after running samples of these fractions in butanol-10 per cent acetic acid and a description of the isolation of 3.0 α -aminobutyric acid have been published.⁶

A total weight of 50 g. glutamine of a high degree of purity was isolated. This yield represented 2.8 g. per kg. of fresh beetroot and accounted for 85 per cent of the total amount of glutamine estimated to be present. Nearly 30 g. betaine was recovered from the same extract.

This work was carried out as part of the programme of the Food Investigation Organisation of the Department of Scientific and Industrial Research.

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Co-ordinating Electrodeposition

FORMATION of an International Council for Electrodeposition is announced by the Institute of Metal Finishing (incorporating the Electrodepositors' Technical Society) in conjunction with the American Electroplaters' Society.

Object of the council is to initiate and co-ordinate all activities of member societies where international action is necessary or desirable. Such activities may include the holding of international functions, questions of nomenclature and terminology, etc.

Representation on the council is initially confined to the Institute of Metal Finishing and the American Electroplaters' Society. Membership is, however, open to any society of which one of the main interests is the subject of electrodeposition.

Headquarters of the International Council are 27 Islington High Street, London, N.1, and the honorary officers are: *Chairman*: Mr. H. Silman (president, Institute of Metal Finishing); *Hon. Corresponding Secretary*: Dr. S. Wernick (hon. secretary, Institute of Metal Finishing); Dr. W. R. Meyer (American Electroplaters' Society); Mr. W. L. Pinner (American Electroplaters' Society).

A Survey of Plant Protection*

by J. F. H. CRONSHEY, M.A., Dip.Agric.

IT would be pleasant to begin this review of the uses and testing of fungicides by connecting it with some anniversary, but dates are not always amenable to discipline. It is not exactly 200 years since the reason for seed treatment of wheat was first explored and established in 1751-52. (It is more like 2,000 since seed treatment was first practised!) Nor is it 100 years since foliage fungicides were first used. Sulphur was certainly used as early as 1821 and Bordeaux Mixture was not deliberately used for disease control till 1883. It is, however, very nearly 200 years since Mathieu Tillet demonstrated the reasons for the success of seed treatment for wheat in 1751-52 and it is about a century since the connection between fungi and many foliage diseases was appreciated. How have the two chemical methods of seed and foliage treatment developed since their inception and why?

It is natural that early work should be largely the development and field testing (on a wide range of diseases) of simple variations of the original materials. In the first place the materials discovered had to be effective when application methods were rather primitive. They therefore had to be very good to be chosen at all. In the second, there were innumerable newly discovered diseases urgently needing treatment.

First World War Period

During most of the period before the 1914-18 War this was the type of development which took place. By that time copper and sulphur treatments were firmly established; Bordeaux Mixture and the various modifications of it for foliage treatment, lime sulphur and sulphur dust for the same purpose, and copper sulphate for treatment of Bunt of wheat. During the Great War, formalin, first discovered as a seed treatment in 1896, developed very rapidly in Germany owing to the shortage of copper sulphate. Concurrently, the preliminary work was in progress on the organo-mercurial seed treatments which might be described as the first of the major modern

developments (E. Riehm, 1914). There was no major development in foliage fungicides until considerably later.

Foliage Sprays

The development of a large range of foliage fungicides is really remarkably recent. As late as 1940, Martin could give 45 pages to copper and sulphur and only five to all other materials. While this was undoubtedly due in part to the excellent quality of the first fungicides, it was probably largely connected with the absence of methods for testing new materials quickly. The rapid testing of large numbers of materials can only be accomplished when satisfactory techniques have been evolved and there were no suitable techniques in the early days. A number of materials, none of them better than the first few, were suggested before 1920, but the testing of really large numbers of materials has only been undertaken in the last 30 years. It has been done in connection with the major development in organic chemicals.

Quick and simple laboratory tests were described in Germany in 1924 (Schmidt, 1924), but they did not give reliable correlation with field performance (Kotle, 1924). Schmidt (1925), answering Kotle's criticisms, had already appreciated the importance of consistency of the test organism. Similar techniques were in use in England and America, but they have required many refinements to yield satisfactory results. One comprehensive survey conducted by the Shirley Institute (Fargher, *et al.*, 1930), showed the possibility of using salicylanilide as a fungicide. The survey was in connection with textiles, but this material has since been developed as a foliage fungicide. Our tests indicate that to-day, 20 years later, it is still equal to the best modern fungicides for the specific purpose of Tomato Leaf Mould (*Cladosporium fulvum*) control under glass. This fungicide provides an interesting example of the importance of factors other than direct phytotoxicity and efficiency. Its use in England decreased after an initial period of success because it was not safe to apply when oil was used for red spider control. The use of other materials for red

* A paper read at the International Agricultural Conference organised by Plant Protection Ltd., and held at Fernhurst, June, 1951.

spider removes this disadvantage.

In the 1930's, work at several laboratories, particularly on bio-assay, had very greatly improved the reliability of tests and also had extended the scope of the materials examined. Whetzel and McCallan (1930), McCallan and Wilcoxon (1932), Rippel (1932), Marsh (1936), Anon (1936), Anon (1937), Marsh (1938), Montgomery and Moore (1938), may be cited, but the amount of work necessary on technique and the time it has taken to accomplish are well exemplified by the fact that publications in the 1940's have still dealt with refinements and standardisation of essentially similar tests, against spores on coated slides, to those mentioned in the early 1920's (Hamilton, 1940; Anon, 1943; Martin, 1943). A similar test had been used 100 years earlier (Prevost, 1807).

Preliminary Work

Concurrently workers have attempted to develop tests on plants in the laboratory and the field (Staudermann, 1937; Nielson, 1942; Stoddard and Heuberger, 1943; McCallan and Wellman, 1943), which would provide a bridge between the slide test and the field test and facilitate the further sorting of promising candidates before full-scale field testing. Here at Fernhurst (as no doubt at many other stations) we have third-stage tests in which we use a variety of organisms in semi-natural field trials to test true field performance of materials that come to us for testing. Currently, we are using Tomato Leaf Mould (*Cladosporium fulvum*) and Cucumber Mildew (*Erysiphe cichoracearum*) in the greenhouse and Tulip Fire (*Botrytis tulipae*), Apple scab (*Venturia inaequalis*), Potato Blight or Late Blight (*Phytophthora infestans*) and Celery Leaf Spot (*Septoria apii-graveolentis*) in the field. We put the materials to a field test but in all cases we endeavour to ensure the success of the test by providing ample disease inoculum. We do not continually inoculate the test plots, but we do inoculate once or twice, or introduce disease material, to make sure the disease starts even in an unfavourable season.

What do all these tests do? A very high percentage of all the materials examined for use against foliage diseases have been put, in all stages, through tests which emphasise the importance of stopping a fungus spore causing infection. The standard laboratory

test described in 1943 (Anon, 1943) differs from that of 20 years earlier (Schmidt, 1924) not in essence but rather in accuracy, refinement, and range of test organisms used. 'Will it stop a spore germinating?' though, fortunately, not the only question asked, has been the question most frequently stressed. Such a test may well detect materials that will do other things, but it is inherently likely that it will favour 'protective' fungicides that prevent infection by spores as does Bordeaux Mixture. In fact 'Standard Bordeaux' has been described for use as a standard in the test (Anon, 1943(2)).

Even techniques employing plants in the laboratory, though they can certainly be used to examine materials in different ways, have been applied in many cases to give an essentially similar test.

What has been the result? Workers in this field are confronted with an ever-increasing and already tiresomely long list of ever more complex (and often still more expensive) materials, each with its preliminary promise of outstanding success and nearly every one with its failure to live up to the early promise. It is not desired to minimise present achievement. New diseases have been brought under control, and many new fungicides are far more active than the old; far smaller amounts of them will do the job. But the old materials were cheap, and most of the new are expensive, so that the increased activity is not generally balanced by a reduction in cost to the grower, and this, surely, is what matters.

Two Vulnerable Points

With a few exceptions, therefore, there are only two vulnerable points in the old fungicides that have so far permitted the new to become established. One is damage to crops due to phytotoxicity of the fungicide. The early fungicides were phytotoxic, especially to some crops. Many apple varieties cannot be treated with copper and some will not tolerate lime sulphur; tulips will not tolerate copper and lettuce and brassicas are often damaged; sulphur dusting or fumigation hardens greenhouse cucumbers and tomatoes. The list can be multiplied with ease, and so can the list of fungicides that have been tried on these diseases and, often, adopted. Ferbam, organo-mercurials, glyoxalidine and others on fruit; ferbam and thiram on tulips, nabam and ziram on vegetables, with many other

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materials still on trial or in small-scale use.

The influence of damage does not end with crops that will not tolerate the older materials. The success of alternative materials on apples is not only due to this, but also to the fact that many varieties classified as sulphur-tolerant suffer more or less damage so that, in fact, they were only classed as tolerant because they still gave some crop. They grow much better when treated with other materials. Similarly, the damage done by copper sprays to potatoes and tomatoes has led to widespread use of thiocarbamates on these crops in the U.S.A., because lack of damage means higher yields and better plants.

Such considerations, however, require careful assessment in relation to economics before they are translated to other areas or countries. We in Plant Protection have often been asked about the use of thiocarbamates for potato Late Blight. In the first place, Early Blight (*Alternaria solani*) and other diseases are probably collectively as important as Late Blight (*Phytophthora infestans*) in some of the places where thiocarbamates are recommended. In the second, the time when spraying has to be started has a material effect on the loss by phytotoxic spray damage. Where old and young plants may be close together in an area, as in Florida, it may be necessary to start spraying very early in the life of the potato or tomato crop. This is not generally the case in Europe; and its effect is well illustrated by a phytotoxicity trial in potatoes conducted in 1949, when 'Blight' was unimportant in England. Potatoes were sprayed three times, at fortnightly intervals, as is common practice in this country, but the spraying was started at various times in

different series, the earliest start being when the majority of the plants had only been above ground for a few days. This was a highly-replicated precision experiment and it shows that stronger copper sprays than are used, applied ridiculously early could cause a yield-loss of about 15 per cent. Starting at the stage of growth which is usual, however, and using a normal strength, the indications are that the loss would be around 3 per cent. Anyway, less than 5 per cent. (Table I)

Similarly, an elaborate tomato trial, with five replicates of 48 series, showed that we could reduce tomato yields by 20 per cent odd in England, but schedules used in practice would cause only 2-4 per cent loss (Table II). It takes aggravatingly complicated experiments to attain the precision needed for this sort of comparison, and one does not willingly do very many of them. We have, however, similar results from another year.

For 'Blight' control, we are, of course, mainly interested in Late Blight, though Early Blight is more important than it was a few years ago. In a dry year, so dry for England that it was quite unnecessary to spray at all in practice, spraying three times per fortnight with thiocarbamates did give us control of artificially-induced Late Blight

TABLE I
POTATO PHYTOTOXICITY TRIAL, FERNHURST, 1949
(Yield Data in lb. per plant)

Time of First Spraying	Percentage of Copper			Average
	0	$\frac{1}{2}$	1	
Late May ..	1.73	1.61 (90)	1.52 (86)	1.62
End May ..	1.77	1.55 (88)	1.56 (88)	1.63
Early June ..	1.77	1.70 (97)	1.63 (93)	1.70
Mid-June ..	1.78	1.72 (98)	1.65 (94)	1.72
Average	1.76 (100)	1.65	1.59	—

Figures in parenthesis are yields expressed as percentages of the mean yield of the unsprayed plants, 1.76 lb.

TABLE II
TOMATO PHYTOTOXICITY EXPERIMENT, FERNHURST, 1949
(Yields in lb. per plant)

Frequency of Spraying and Strength of Spray	Bordeaux Mixture	Perenox (cuprous ox.)	Materials Used		Thiram	Zineb	Averages	
			Cuprous Oxide	Salicylanilide			Copper	Organic
3 times in 2 weeks	2N	7.8	7.4	9.2	9.6	9.8	9.4	9.6
" "	N	9.2	8.5	8.1	10.6	9.8	9.2	9.9
" "	N/2	9.5	8.8	8.8	9.7	10.2	9.4	9.8
Average		8.8	8.2	8.7	10.0	9.9	9.3	9.8
Once in 2 weeks	2N	9.7	8.9	9.0	9.9	9.4	10.3	9.2
" "	N	9.7	9.3	9.7	10.0	9.3	9.6	9.7
" "	N/2	10.1	9.3	9.8	10.2	9.9	10.2	9.8
Average		9.8	9.2	9.5	10.0	9.5	10.0	9.5
Unsprayed controls		9.8	9.9	9.4	10.1	9.3	10.6	9.9
		9.7	10.4	9.9	9.7	10.3	9.4	

Note.—N = $\frac{1}{2}$ % copper or 0.15% organic active ingredient.

(Tables III and IV). In a wet year, however, the thiocarbamates three times per fortnight were appreciably worse than the worst of the copper sprays once per fortnight (Table V).

Obviously there is little to commend thiocarbamate spraying on potatoes and outdoor tomatoes in England until some radical change occurs. Yet it would be quite possible to imagine that there was a good case for it. In all our experiments, phytotoxic damage to foliage has been quite visible and the (pre-Blight!) appearance of the plants sprayed with thiocarbamates was obviously better. We have even imagined that we could see better crops on the tomatoes—as if one could see a difference of well under 20 per cent in weight of fruit!

The other reason that has favoured the newer organic sprays against the older fungicides is the reduction of visible deposit on fruit and ornamentals. This is of considerable importance in some cases and has prevented the application of treatments, e.g., sulphur dust on chrysanthemums near to flowering—that would otherwise have been successful.

TABLE III
POTATO BLIGHT EXPERIMENT, FERNHURST, 1949
(Data from Disease Assessments and Yields)

Series and Treatments	No. of Stems with Blight lesions on 80 plants	7 Oct. Date when grading figures per plot*	Yield in lb. per plant
(1) Control, unsprayed	124	25 Sept.	2.8
(2) Bordeaux mixture at 2.5% Cu, once in 2 weeks	1	45 8 Oct.	3.0
(3) Perenox at 0.25% Cu, once in 2 weeks	1	47 8 Oct.	3.1
(4) Experimental Cuprous oxide at 0.25% Cu, once in 2 weeks	2	51 7 Oct.	2.9
(5) Copper oxy-chloride at 0.25% Cu, once in 2 weeks	4	58 6 Oct.	3.0
(6) Fernite at 0.15% TMDT, once in 2 weeks	50	85 1 Oct.	2.7
(7) Fernite at 0.15% TMDT, 3 times in 2 weeks	6	34 9 Oct.	3.2
(8) Zineb at 0.15% zinc ethylene bisdithio carbamate, 3 times in 2 weeks	8	55 6 Oct.	3.1

* The grades used are such that these figures approximate to per cent foliage destroyed in the middle of the range. At the top of the range, the figures are lower than the true percentage figure.

TABLE IV
TOMATO BLIGHT EXPERIMENT, FERNHURST, 1949
(Totals for the Five Replicates in Each Series)
Leaflets with Blight on the Top Four Leaves

Frequency of Spraying and Strength of Spray		Bordeaux Mixture	Perenox (cuprous ox.)	Materials Used				Zineb	Averages	
				Cuprous Oxide	Salicylanilide	Thiram			Copper	Thiocarbamates
3 times in 2 weeks	2N	0	0	0	20	1	0	0	0	0
"	N	0	0	0	14	1	0	0	0	0
"	N/2	0	1	0	36	3	2	0	2	
Average		0	0	0	23	2	1	0	1	
Once in 2 weeks	2N	0	0	0	49	14	12	0	13	
"	N	2	1	0	67	30	32	1	31	
"	N/2	0	0	1	56	19	31	0	25	
Average		1	0	0	57	21	25	0	23	
Unsprayed controls		106	106	133	86	83	95	—	—	—
		102	131	108	142	104	101	—	—	—
Control average		—	—	—	—	—	—	—	—	108
Severity of Disease on 17/10/49 (Visual Grades)										
3 times in 2 weeks	2N	0	0	0	6	0	1	0	0	
"	2N	0	0	0	7	2	0	0	1	
"	N/2	0	1	0	13	1	1	0	1	
Average		0	0	0	9	1	1	0	1	
Once in 2 weeks	2N	0	1	1	20	5	5	1	5	
"	N	0	0	3	19	7	9	1	8	
"	N/2	0	0	1	16	7	10	0	8	
Average		0	0	2	18	6	8	1	7	
Unsprayed controls		29	31	43	29	28	17	—	—	—
		32	24	25	24	34	29	—	—	—
Control average		—	—	—	—	—	—	—	—	29

Note.—N (=normal strength) is defined as 0.25 per cent. copper or 0.15 per cent. organic active ingredient in the spray.

A review of this kind would be incomplete without mention of the large amount of work done on supplementary materials—wettters and stickers. Physical properties affecting the penetration and tenacity of the spray have a profound effect on the relation between laboratory and field performance (Martin, 1940), and no doubt it is the change of copper concentration and availability with time in Bordeaux Mixture (Wilcoxon and McCallan, 1938) that causes its apparent superiority in field performance. A study of ordinary commercial and other recommendations, however, suggests that the use of these materials in practice is still an art rather than a science.

One final point; it is customary to comment on the specificity of the modern fungicides compared to the old ones. But most of the modern organic fungicides will do quite a range of jobs. Are not Bordeaux Mixture and lime sulphur also better on some diseases than on others? There certainly are marked differences with the modern materials but it is thought that this specificity is often exaggerated.

Seed Treatment

Seed treatment had a long start over foliage treatment and, though little detail has been given in the introduction to this survey, a considerable number of materials had been quite thoroughly tested by 1914 (Martin, 1940). The two major advances made about the time of the first world war were the introduction of dusts (Darnell Smith, 1915), and the development of organo-mercurials (Riehm, 1914). These two were not, initially, linked and the convenience of dust treatment led to the adoption of copper carbonate treatment on a limited scale in many countries. Riehm (1920 and 1923) and other German workers (Gassner, 1923), continued their work on organo-mercurials and it was not long before a general review could be published including organo-mercurials, used as dusts, in which it was already appreciated that these materials controlled a whole range of diseases; several cereal smuts, leaf stripe diseases (*Pyrenophora—Helminthosporium*) and also foot rots (*Fusarium* and allied diseases) (Gram, 1926).

The success of the treatments against a range of diseases led to trials on a variety of crops and organo-mercurials (Brett, Dillon, Weston and Booer, 1937) and copper (Horsfall, 1932) were found useful

Material Used and Concentration	Frequency of Application	Date When Foliage was Half-Dead	Days Pro-longation of Growth	Yield Pounds per Plant (°)
Bordeaux mixture, freshly prepared, 0.25% Cu.	Once every 2 weeks (°)	26 Sept.	38	3.20
Cuprous oxide 0.25% Cu.	"	16 Sept.	28	3.20
Cuprous oxide 2.06% Cu. applied low volume (°)	"	27 Sept.	39	2.97
Copper oxychloride 0.25% Cu. (°)	"	15 Sept.	27	3.22
Copper oxychloride 0.25% Cu. (°)	"	14 Sept.	26	3.31
Thiram 0.16%	3 times every 2 weeks (°)	9 Sept.	21	3.18
Zineb 0.16%	"	6 Sept.	18	2.95
Control, unsprayed	—	19 Aug.	—	2.45

(°) The 'low volume' application was intended to be at about 12 gallons per acre as against 100 in the normal high volume. In fact, the application was rather higher than intended and this series received slightly too much copper.

(°) Two different formulations.

(°) Five applications, starting 30 June.

(°) Fifteen applications, starting 30 June.

(°) As the yield was substantially made by the first week of September, there is no significant difference between the treated series.

against damping-off. Damping-off of peas has now been recommended for use as a laboratory test of fungicides (McCallan, 1947 and 1948).

Seed treatment, originally developed to kill fungus spores on the surface of the seed and so protect the plant, has been used for a much wider range of purposes. Promising modern fungicides have been tested for seed treatments as well as foliage sprays and a few of them have proved particularly suitable as protective dressings to prevent damping-off and allied diseases. Thiram probably has the widest range of uses and is the most versatile, but tetrachlorobenzoquinone and 2,3-dichloro-1,4-naphthaquinone are also valuable for a range of uses and there are other promising materials less fully evaluated. An interesting newcomer is hexachlorobenzene, discovered in France, which appears to be a specific for Wheat Bunt (*Tilletia caries*).

The relative values and action of copper, mercurial, and modern organic seed treatments are well illustrated by a laboratory experiment on beet (Table VI). The seed clusters used in this experiment were heavily contaminated with *Phoma betal* and the experiment included series planted in sterilised soil and in soil contaminated with *Pythium ultimum* and *Corticium solani*. The experiment was thus deliberately

TABLE VI
EMERGENCE, AND POST-EMERGENCE LOSSES

Material Used and Rate of Application	(In a Laboratory Test of Seed Treatments)			
	Total Emergence (%)		Losses as per cent Sterilised Con- taminated Soil (%)	
0.3% N-trichloro- methylthio tetra- hydrophthalimide	177	178	13.0	20.2
0.6% tetrachloro-para- benzoquinone	162	140	19.8	37.1
0.3% 2,3-dichloro-1, 4-naphthoquinone	160	196	5.6	9.7
0.3% Thiram (various formula- tions)	175	186	0.6	7.4
" "	182	171	2.2	4.7
" "	200	195	1.5	2.0
" "	203	167	3.0	3.7
0.006% Hg (C)	183	187	5.5	15.0
0.006% Hg (C)	172	176	10.5	31.8
0.01% Hg (C)	199	161	4.5	16.8
0.3% Cu (C)	153	156	29.4	25.6
Control, untreated	168	112	31.6	34.8

(C) From 120 clusters.

(P) Contaminated with *Pythium ultimum* and *Corticium* (*Phiocotonia*) *solani*.

(O) Organically combined mercury; 'Agrosan' GN formula.

(A) As cuprous oxide.

designed to test materials against seed-borne and soil-borne infections of very different fungi.

Organic mercury is definitely better than materials like thiram and the quinone derivatives for the cereal smuts. For protection against *Phoma*, *Pythium*, *Rhizoctonia*, however, the superiority is very much on the other side! Thiram, in particular, gives greatly superior protection against post-emergence damping-off from the various causes. There are many other interesting comparisons in the figures, but it is not proposed to discuss them here.

This trial has, however, been chosen for another reason. It is a small greenhouse test involving little labour and only moderate facilities. Admittedly Horsfall (1945) could legitimately complain that it is so slow a method of testing that it 'creeps', but it is extremely simple and unexacting in terms of labour, compared with a field trial of a foliage fungicide, and so are field tests of seed treatments. It is not difficult to put a lot of materials through field tests against the diseases concerned in seed treatment, whereas it is a most exhausting process to endeavour to amass a similar amount of information on foliage fungicides. Further, it is remarkable how closely the greenhouse test can reflect field results in seed treatments. Consequently, while many interesting and useful laboratory techniques have been worked out (e.g., Muskett, 1938), pro-

gress in seed treatment has been much less dependent on them. Is this the reason for the comparatively short list of materials with their well-defined uses, or does the reason lie elsewhere?

Discussion and Conclusion

This short review has not attempted to cover the full field or to present an unbiased picture. Important methods of testing—e.g., burial of impregnated textiles and wood blocks—have simply been ignored, and little attention has been paid to the 'borrowing' from one method to another. Yet useful crop protection materials have in fact been discovered through tests, such as those mentioned just above, that were devised for quite a different purpose.

This is rather intended as an exposition of a point of view, to make, perhaps, a rather obvious point. It is that the simplicity of the seed treatment situation, the concrete nature of the information on treatment, and the clarity of the stage that research has reached, are in marked contrast to the multiplicity and confusion in the field of foliage fungicides. Is not this due to better and more complete experimental data, and do we not need better and more varied tests of foliage fungicides—tests that will agree with field performance?

And why so much emphasis on protection? Did Riehm, back in 1923, when he corrected loose talk that confused disease prevention with disease treatment, frighten everyone from thinking further of it for twenty years? New methods of treatment and new techniques are just beginning to appear now and, with the enormous number of chemicals that are available, it is suggested that new methods will be found when techniques are devised to disclose them. Can we not have some new hoops, instead of putting all the new performers through the same hoops?

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Flue Dust Removal Plants

Economy of Fuel and Cleaning

OF interest to the chemical and allied industry are the 'Heat Economy' flue dust removal plants now employed in many boiler houses in this country, particularly for use with Lancashire and similar boilers.

At the present critical time the need for conserving rapidly dwindling fuel resources means that every method of coal saving must be employed. It is essential both that boilers should be kept in a spotlessly clean condition and at the same time that the cleaning process should not mean that they have to be shut down, this being extremely wasteful in labour, production and fuel.

It is now widely recognised that mechanical, automatic removal of flue dust is necessary in order that the boilers can be maintained at an economical level. One of the most efficient methods is said to be the

flue dust removal plant manufactured by Heat Economy, Ltd., of 13-21 Hoxton Street, London, N.1, whose equipment has been specially designed for dust removal from Lancashire boilers with steam working pressure from 80 to 200 lb. per sq. in.

For small boiler houses the blower plant can be installed without the dust collector, the flue dust being raked out by hand, but for large boiler houses the combined blower and suction plant is recommended, and the fly ashes in both cases are removed without shutting down the boiler.

The blower plant and suction plant are two separate installations. In the former all the boiler flues are fitted with soot blowers which are operated intermittently once a day for a few minutes only. The soot blowers convey the flue dust to the front end of the bottom flue and are arranged in groups, each group being provided with a steam supply tubing from a special rotary valve, in which a master valve and a drain valve is incorporated. The whole operation is extremely simple and consists of merely turning the hand wheel of the rotary valve one revolution.

The 'Heat Economy' suction plant consists of a cyclone separator of special design for collecting the hot and very fine fly ash. The necessary vacuum is created by a single-stage steam jet air injector with condenser and water spray. One suction nozzle is installed in each boiler, and the flue dust conveyed by the dust-conveying tubing into the cyclone, from where it can be discharged directly into trucks or lorries without causing any nuisance to the surrounding area. Special cast iron bends and branches with replaceable inspection covers are used on the dust-conveying tubing.

Among the advantages of the plants are simple operation with no manual cleaning, and considerable fuel saving by virtue of the flues being in a permanently clean condition, with the boilers continuously in commission.

Copper-Zinc Exports

The Board of Trade announced on 15 January that in conformity with the recommendations of the International Materials Conference exports of semi-manufactured copper and zinc and their alloys in the first quarter of 1952, and until further notice, will be licensed at 80 per cent of the rate of export in 1950.

Upward Trend Continues

Increased Consumption of Nitrogen

CONTINUANCE of the upward trend in both production and consumption of nitrogen was shown in the world estimates for the year 1950/51 in the 31st annual report of the British Sulphate of Ammonia Federation, Limited, for the year ended 30 June, 1951. Total production of nitrogen rose by about 5 per cent. Production and consumption of industrial nitrogen increased by 17 per cent. Agricultural consumption, estimated at 4,290,000 metric tons, exceeded the figures for the previous year by 12 per cent and was slightly above the output for the year, thereby reducing accumulated working stocks. Several plants in various countries planned to start in 1950/51 would not begin production until 1951/52.

Production Higher Than 1949

Total U.K. production of nitrogen products in the calendar year 1950 was 6.2 per cent higher than in 1949. Output of fertiliser products fell by 2.6 per cent, but there was an increase of 40 per cent in industrial forms.

As in 1950, farmers placed orders for large quantities for delivery in May and June, 1951, prior to the increase in price rendered necessary by the removal on 1 July of the remainder of the subsidy on fertilisers. It was estimated that the cumulative carry forward to the 1951/52 season might thus have amounted to 30,000 tons nitrogen, and that on this basis actual usage was 206,335 metric tons in 1950/51 and 205,660 tons in the previous year.

Bad weather in the autumn and continuous rain in the spring decreased the use of sulphate of ammonia on arable land, while the subsidy removal was a further adverse factor, resulting as it did in a substantial increase in the cost of sulphate of ammonia and other fertilisers.

In these circumstances a considerable reduction in the use of nitrogen might have been expected. The fact that consumption was maintained was largely due to the growing appreciation by farmers of the importance of grass as a crop, and of the fact that the use of nitrogen on grassland—even at the higher cost—meant a large saving in the replacement of imported and other feeding-stuffs. Reports from all parts of the country showed that there had been a sub-

stantial increase in silage-making and grass-drying, and also in the use of nitrogen to obtain early and late grazing.

Imperial Chemical Industries, Ltd., while continuing its scientific researches on the problems of grass production and conservation, had arranged a large number of demonstrations on a farm scale throughout the country. Sir James Scott Watson, C.B.E., Chief Scientific and Agricultural Adviser to the Ministry of Agriculture, presided over an important Grassland Conference at the I.C.I. Dairy House Farm in Cheshire, which was attended by over 400 leading British grassland farmers and technicians, and also by many agriculturists from overseas.

Exports of sulphate of ammonia during 1950/51 were 14 per cent less than 1949/50. During the year the Board of Trade continued to control the allocation of all forms of nitrogenous fertilisers exported from the United Kingdom.

Materials of construction had received special attention from the Research Department. Experiments on the use of resin cements and lacquers for protective coatings against attack by both acid and alkaline liquors had been intensified and a fair measure of success achieved.

Two new members had joined the federation during the year, bringing the total to 75.

New Sulphuric Acid Plant

THE new sulphuric acid plant of Scottish Agricultural Industries, Ltd., at Sandilands Chemical Works, Aberdeen, will be ready in the latter part of 1952 if no delays intervene, it is reported. The plant will produce 37,000 tons of 100 per cent sulphuric acid and will feed the superphosphate requirements of the North East fertiliser industry, as well as providing a marketable surplus. In addition to this pyrites-burning plant—which is the most modern constructed in this country in recent years and introduces a number of new developments—the company is to undertake the doubling of their pyrites-burning plant at Carnoustie. The annual report of the company which announces these developments indicates that the year had been completed in conditions of increasing difficulty. Decreased buying power in the farming industry retarded the growth of expansion and made 1950-51 a rather less spectacular year than the previous post-war years.

Recent Advances in NPK Analysis

British and American Methods Compared

SOME comparisons between American and British methods of NPK analysis and methods for the determination of potassium in fertilisers were discussed in papers presented before members of the Fertiliser Society at its meeting held in London on Thursday, 10 January.

Although Dr. J. Hubert Hamence, F.R.I.C., took as the title of his paper 'Recent Advances in NPK Analysis', he actually gave a survey of the whole field of analysis, because he felt that a fuller knowledge of the limitations and imperfections of well established methods might be as valuable to the analyst as description of the results of the most recent methods.

In Great Britain the methods of the NPK analysis were largely tied up with the Official Fertiliser and Feeding Stuffs Regulations and it seemed that mechanism for their revision was slow and ponderous compared with the ease by which the methods of the American Association of Official Agricultural Chemists (AOAC) might be revised.

Three main forms of nitrogen had to be dealt with organic, ammoniacal and nitric. Individually determination of the different forms of nitrogen presented no serious difficulties to the analyst but collectively they might be quite a different story.

Organic nitrogen was always determined by the Kjeldahl process in which the nitrogen was converted to ammonium by heating with concentrated sulphuric acid in the presence of a catalyst. Mercury was generally found to be the most efficient catalyst, although a mixed catalyst was sometimes favoured. However, it should be noted that a mixed catalyst of mercuric oxide and selenium might result in a loss of nitrogen during the digestion process.

Ammoniacal Nitrogen

Ammoniacal nitrogen called for little comment when other forms were absent, straight distillation with alkali giving a theoretical recovery.

Nitric nitrogen was the most difficult form to determine. Present English official regulations prescribed two procedures, the Ulch and the Devarda Alloy methods.

Alternative processes given in the AOAC

include distillation with ferrous sulphate, zinc dust and sodium hydroxide which gives good results and had the advantage that the blanks were both lower and more consistent than those obtained by the Devarda method and that no initial gentle digestion was required. Some American workers favoured the modified Kjeldahl or Jodlbauer method.

Individual forms of nitrogen in mixtures were undoubtedly the most difficult nitrogen determinations to make and Dr. Hamence considered that the methods at present available were capable of giving only a fair approximation of the different forms present but were not capable of giving theoretical estimations.

Phosphoric Acid Estimation

Both the English and American official methods of analysis relied on the molybdc or Jorgensen method for the estimation of phosphoric acid. This method consisted essentially in the separation of the phosphoric acid from interfering substances as ammonium phospho-molybdate followed by solution in ammonia and final precipitation as magnesium ammonium phosphate with magnesia mixture. While the method might be somewhat lengthy nevertheless it was capable of giving very accurate results.

Another process not so well known perhaps but capable of giving equally good results was the citric-oxalic-magnesia method.

Of the three elements the one which had caused the most trouble in its determination was potassium.

In general it might be said that there were two main methods for the determination of potash: perchloric acid, and platinic chloride.

When the fertilisers under examination were pure salts such as 99 per cent muriate of potash the methods were simple and were capable of giving very good recoveries. It was the impurities and interfering substances naturally present in the commercial potash fertilisers and mixed fertilisers which gave rise to the troubles.

In America the platinum method found favour and in the past 10 years many papers had appeared in the *Journal of the Official*

Agricultural Chemists on its determination. The perchloric acid method was however generally preferred in England and on the Continent—although owing to improvements in technique the platinum method was rapidly gaining ground in England.

Undoubtedly the greatest advance of recent years in the platinum method lay in the introduction of the Perrin technique, by which one could obtain the potash content of a mixed fertiliser in a few hours.

A comparatively recent development was the application of flame photometry, originally designed for soil work, to mixed fertilisers.

Radioactivity Determination

One of the most recent advances in potash analysis consisted in its determination from measurements of its radioactivity. The method had the great advantage that no preliminary preparation other than grinding was required and the method was rapid.

Of recent years a number of micro and semi-micro methods had been described for the determination of NPK but such methods were not suitable for fertiliser analysis, due to difficulties of sampling.

In his 'Review of Methods for the Determination of Potassium in Fertilisers' R. Donald, A.R.I.C., said that it was necessary to consider the lengthy methods in the Fertiliser and Feeding Stuffs Regulations and the development, by manufacturers and others, of control methods for investigative work which could give more rapid results.

The aim of the analyst must be to obtain a method which combined the speed of the routine method with the accuracy of an official process, and results of some of the newer methods appeared to indicate that this was nearing achievement.

In conclusion, Mr. Donald summed up by saying that many of the details of procedure in the existing F. & S. Reg. Methods for the determination of potassium had been found to be unsound and it was known that the alternative methods permitted could give different results. This was unsatisfactory for official purposes and it was generally acknowledged that a revision was necessary.

This appeared to indicate a need for collaborative work such as was practised by the AOAC and he considered that a somewhat similar organisation, perhaps composed of members representing manufacturers, public

analysts, agricultural colleges and research stations might, with advantage, be formed in this country.

'Photometric Determination of Potassium in Fertilisers Using Dipicrylamine', was described in a paper by W. C. Hanson, A.R.I.C., in which he gave an account of a rapid method suitable for use in the works laboratory, which had been developed in the research department of Fisons, Ltd.

Temperature at which the precipitation of the potassium dipicrylamine was to be carried out had, of course, to be fixed. At the outset, it was decided that 0°C. was the most convenient temperature.

When the solutions were centrifuged after precipitation, it was found that the crystals were so compressed that they were difficult to dissolve. No suitable method was found for completely separating the mother liquor from the precipitate other than filtration.

Water could not be used owing to the appreciable solubility of the precipitate in it. Various organic solvents were tried. Of these, those miscible with water, e.g., alcohol, and acetone, dissolved the precipitate very readily, while those which were immiscible, e.g., ether, were not efficient.

Quantities of the pure standard potassium solution were precipitated, as in the calibration. All the precipitate was transferred to a weighed sintered glass crucible and washed with an ice-cold aqueous solution of potassium dipicrylamine. The crucible and precipitate was dried at 110°C. to constant weight. The results obtained were within 2.2 per cent of the true values.

Calcium Oxide Used

In the method as at first tried, the solution was boiled with fresh calcium oxide to expel ammonia. This gave results with a maximum error of ± 2.5 per cent as compared with the theoretical. Caustic soda was tried in the place of calcium oxide and this gave low results (within -2.8 per cent). Lithium hydroxide which was adopted finally gave results within ± 2.2 per cent.

The absorptiometer was calibrated by taking quantities of standard potassium solution containing amounts of K_2O from 1 to 6 mgm. These quantities were measured from a micro-burette into small test tubes, $\frac{1}{8}$ in. by 4 in., accurately graduated at 5 ml., and the volume adjusted to the 5 ml. mark with water.

German Chemical Industry in 1951

Post-War Rehabilitation Completed

OUTPUT of chemical products in Western Germany during 1951 has been provisionally put at DM 9,000 millions, a substantial advance on the preceding year. Continuation of the steep increase in production which has marked recent years is, however, considered unlikely in present circumstances. The output curve has indeed already flattened out. According to the official index, the output of the West German chemical industry rose in the early part of the past year to a new high level of 147 per cent (by volume) of the 1936 average in April and May, compared with the previous record of 132 in October 1950.

In the summer months, however, production declined owing to overstocking by customers and financial embarrassment caused by lack of liquid funds. There was a partial recovery in the autumn which raised the production index to 143 in September and October, but this was followed by another decline due to shortage of coal and electric power in the last two months of the year.

Scarcity of Plant

Further output gains have probably been limited by the scarcity of plant available. Sulphuric acid, chlorine, caustic soda and calcium carbide continued to present serious bottlenecks even when the Allied ban on new chlorine and caustic soda plant had been eased. The production of calcium carbide and its derivatives was seriously reduced by shortage of electric power in the last few months of the year, and other manufacturers complained about shortage of allocation coal and high prices for imported 'free' coal.

Other raw materials, of course, also advanced in price, a trend which gave a fresh impetus to the development of alternative fuels and raw materials—always a subject of great interest to German chemists. It is hoped that recent research will result in increased and improved use of coke-oven by-products and that large-scale oil refining will provide the German chemical industry with sufficiently large quantities of petroleum derivatives for a really important petroleum-chemicals industry.

Export trade in chemical products was

substantially increased in 1951 and probably absorbed over 20 per cent of the total production, not counting indirect chemical exports in the form of finished manufactures of other industries. The chemical industry now accounts for about 15 per cent of all German exports, and many important chemical manufacturers sell 30 per cent and even more of their production in foreign markets. Trade with eastern Europe, where Czechoslovakia, Hungary and Roumania used to be important customers for German chemicals has dwindled.

Chemical Exports Absorbed

Commerce with western Europe, on the other hand, has greatly profited from ERP and OEEC arrangements and now absorbs about 70 per cent of all chemical exports from Western Germany, compared with less than 50 per cent before the war. Part of this increase no doubt is due to foreign exchange considerations which caused manufacturers to route their exports through certain European countries, but trade liberalisation certainly helped German chemical manufacturers to regain pre-war markets.

Little over 10 per cent of German chemical exports go to dollar markets at present—about 7 per cent to the U.S.A. and the remainder to South America and Asia. German chemical exports to overseas sterling countries, on the other hand, have increased and are now as important as the dollar sales. This is largely due to favourable commercial agreements, especially with South Africa and Australia; India and Pakistan are regarded as markets offering opportunities for further expansion of German chemical exports. Similarly, German manufacturers hope to increase their sales in the Middle East, especially Turkey and Egypt.

* More attention, however, is to be paid to intermediates and finished products because the production of heavy chemicals cannot be expanded by German producers as rapidly as they would wish without much greater financial resources than are at their disposal, quite apart from the fact that many overseas countries tend to increase their local production of bulk chemicals in

any case and therefore do not require larger imports of them. German exports are to be expanded in particular in the field of hormones, vitamins and anti-biotics, of high-grade plastics and fully synthetic fibres, of photographic products and dyestuffs.

Several East German producers whose plant has been expropriated by the Soviet Zone Government have been able to make alternative production arrangements in West Berlin and in West Germany. Among the firms concerned are Schering, Fahlberg-List and Kali-Chemie. Annual reports published by leading chemical producers in recent months generally reflect the financial stringency facing most industrial firms in Germany. Comparatively small profits are shown in the annual accounts.

While this conservative financial policy should enable those smaller firms which require comparatively small and inexpensive plant and equipment to carry out the extensions required to expand production further, producers of bulk chemicals complain that they cannot in the present condition of the German capital market secure sufficient finance from outside sources to carry out big expansion schemes.

Plant Engineering Method

British Team's Visit to U.S.A.

PLANT maintenance is a matter of great importance to many industries, particularly at the present time when there is a continual demand for greater productivity although allowances for replacement are totally inadequate and costs of new installations almost prohibitive.

At the beginning of last year a proposal was therefore made to the Anglo-American Council on Productivity, that a team of plant engineers should visit America to study plant engineering methods in the U.S.A., with particular reference to the methods of preventive maintenance in use over there. Since that date, discussions have taken place between the Anglo-American Council, the Council of the Institution of Incorporated Plant Engineers, the Federation of British Industries and other bodies concerned, and the proposal has now been adopted.

A specialist team on Plant Maintenance left on 31 December to spend six weeks in

the U.S.A. studying methods and techniques in the field of plant engineering.

Terms of reference of the team were:—

(a) To study the organisation of American methods of industrial plant servicing and maintenance, with the object of securing maximum productivity.

(b) In particular, to study systems of planned preventive maintenance, with special reference to the statistical control used and to the degree of co-ordination between plant engineer and designer.

(c) To study American wage structures, bonus and incentive systems for maintenance work.

(d) To study safety precautions taken for maintenance personnel.

The team includes the following:—

J. R. Stevenson, leader (works director, EMI Factories, Ltd., Hayes, Middlesex); M. Brookes (chief engineer, Lister & Co., Ltd., Bradford, Yorks); C. E. Halter (plant engineer in charge of refineries, National Oil Refineries, Ltd., Llandarcy, South Wales); T. C. Robinson (works engineer, product works, Imperial Chemical Industries, Ltd., Billingham, Co. Durham); G. C. Allfrey (director of Royal Ordnance Factories (Engineering), Ministry of Supply, London); and F. G. Hilton (Associated Industrial Consultants, London).

DDT-Resistant Lice

THE U.S. army medical service, in co-operation with the U.S. department of agriculture, has developed for use in Korea new insecticides capable of controlling Korean body-lice which are resistant to DDT. New preparations of lindane and pyrethrum powder are being used to protect troops against louse-borne epidemic typhus which might be introduced by infected North Korean and Chinese prisoners-of-war. Both substances are highly effective against the Korean louse and are safe for human use.

As far as is known, DDT is still effective against lice and other insects in most other areas of the world. Both lindane and pyrethrum are actually less potent than DDT against lice in the United States. The U.S. army medical service proposes to carry out a survey to determine the extent of immunity to DDT in insects and other disease-carriers in many countries.



The Chemist's Bookshelf

THE THERMODYNAMICS OF THE STEADY STATE.
By K. G. Denbigh. Methuen & Co.,
Ltd., London. 1951. Pp. 103. Price
6s. 6d. net.

Equilibrium, in the thermodynamic sense, is the time-invariant condition of a closed system. In such a state no spontaneous processes occur and all the thermodynamic properties remain unchanged. Such a condition can, of course, never be entirely realised in practice. Like the concept of an ideal gas, however, the idea of equilibrium substitutes for reality a situation which is more susceptible to analysis. K. G. Denbigh in 'The Thermodynamics of the Steady State' introduces the reader to the notion of another kind of state in which the value of certain properties, for example the temperature, may remain constant in an open system simply because heat is supplied at exactly the same rate at which it is being dissipated. Such a condition, which is not that of thermodynamic equilibrium, is referred to as a stationary or steady state.

The development of the thermodynamic treatment of this subject has given rise to a copious and rather abstruse literature, which it is the object of the present brief monograph to review. Most of the book is devoted to the exposition of the theory and to the elaboration of the principle of microscopic reversibility. The derived relations are then applied to processes, like thermal diffusion, which are particularly susceptible to treatment. Brief reference is also made to tentative applications of the theory to biological problems. Open systems in which the stationary state is encountered are of course common in biology and also in the continuous reaction processes familiar to the industrial chemist. In both these instances however the kinetic rather than the thermodynamic approach has so far been more successful.

The treatment is concise but rigorous throughout and will appeal especially to the busy research worker, to the advanced student, or to the teacher who wishes to keep abreast with modern developments.

With some optimism the publishers offer it also to the 'general reader with a taste for chemistry.' The reviewer feels bound to state that unless the general reader has a firm grounding both in mathematics and in thermodynamics there is some likelihood of a stationary state developing at an early stage in his reading.

The book is another in the series 'Methuens Monographs on Chemical Subjects'.—R.C.P.

KIESELGUHR, GEWINNUNG, VEREDLUNG UND ANWENDUNG. By Dr. Franz Kainer. Ferdinand Enke Verlag, Stuttgart. 1951. Pp. XII + 283. Dm. 35.

Although the establishment of the kieselguhr industry and of practical methods for the application of kieselguhr (wrongly called infusorial earth) was much advanced in Germany and the United States, it was hardly dealt with in literature until recently. Textbooks only mentioned that this material, consisting of the siliceous skeletons of extinct diatoms, being very porous, was used to absorb nitroglycerine in the preparation of dynamite, and in lagging steam pipes to retard loss of heat. The present book, a revised and much amplified edition of the 1936 publication, attempts to correlate all information on kieselguhr and embodies the most recent developments of this industry. It is the first book to outline the subject comprehensively with regard to production, technology and applications.

The information is presented in four sections:—(1) Mining and refining; (2) Chemical, physical, mechanical and thermal properties; (3) Application as raw material, filling and substitute material; (4) Analysis, examination and valuation. A special chapter describes kieselguhr as a filter material and catalyst and there is a 9-page list of international patents. The book contains 32 figures, 31 tables, and 9 charts and concludes with a name and subject index. As some 100 industrial applications of kieselguhr are described in detail, the book should be of interest and value.—F.N.

HOME

Extension Begun

The foundation stone of an extension to the Commonwealth's largest chemical glassware factory—the Quickfit & Quartz, Ltd., works at Stone (Staffs), was laid by Sir Graham Cunningham on 8 January. Sir Graham, chairman and managing director of the Triplex group of companies, said: 'These new works should speed up production of glass chemical plant and make an important contribution towards remedying our adverse balance of payments'.

Gift to Youth Organisation

The Outward Bound Trust, which organises holiday courses for boys in mountaineering and seamanship, has received a donation of £1,500 from the Dunlop Rubber Co., Ltd.

Lower Steel Output

Production of steel in 1951 totalled 15,638,500 tons. This was 654,200 tons less than the record of 16,292,700 tons set up in the previous year, and was the first occasion since the Economic Survey was first published that output has fallen below the estimate. Pig iron production improved slightly with a total of 9,668,800 tons in 1951 as against 9,632,900 tons in 1950.

Moved to Larger Premises

Robert H. S. Robertson, M.A., F.G.S., consultant in raw material development, has moved his consulting practice to larger premises at 16 Kirklee Road, Glasgow, W.2.

Accident Prevention Conference

A special one-day conference on accident prevention is to be held at Caxton Hall, London, on Monday, 25 February. Speakers at the morning session will be Sir Ewart Smith (technical director, I.C.I., Ltd.) on 'Management and Accident Prevention', and J. C. Corrin (assistant general manager, Midlands Employers Mutual Assurance, Ltd.) on 'Accident Prevention in Relation to Common Law Claims'. In the afternoon Dr. K. Biden-Steele (H.M. Medical Inspector of Factories) will discuss 'Some Medical Aspects of Accident Prevention', and Mr. J. O'Dowd (Divisional Organiser, the Iron and Steel Confederation) will speak on 'The Trade Unionist and Accident Prevention'.

Rights Obtained

E.C.D. Ltd., have announced that arrangements have been made for them to manufacture and sell under an exclusive licence in Great Britain, and on a non-exclusive basis in certain other territories the Tonage Ozone Equipment of the Welsbach International, Inc., of Philadelphia, U.S.A.

Low Pressure Research

The Warren Research Fund Committee of the Royal Society is initiating a programme of research on low pressure gaseous discharge and for this purpose has appointed the following research workers for a period of three years: Mr. L. W. Kerr, to work at the University of Birmingham. Mr. C. G. Morgan, to work at University College, Swansea. Dr. E. J. Smith, to work at University College, London. A grant has also been made to Mr. J. M. Somerville, of New England University College, Armidale, Australia, to work for one year at University College, Swansea.

Formula in Error

In our issue of 12 January, on page 48, the structural formula of 2:2'-diquinolyl was inadvertently represented as a non-existent compound containing four nitrogen atoms. There should, of course, have only been two heterocyclic rings, not four.

Parliamentary and Scientific Committee

Nominations for the election of officers of the Parliamentary & Scientific Committee, 1952, are requested by 31 January. Under the constitution no officer is normally eligible for re-election to any office which he has held consecutively for three years. Vice-chairmen retire yearly and are not normally eligible for re-election. Lord Cherwell has resigned as vice-president on accepting ministerial office and two other vice-presidents, Professor E. N. da C. Andrade and Mr. Clement Davies, retire under the three-year rule. Mr. M. Phillips, chairman, is retiring following the change of Government and wishes to nominate in his place Sir Wavell Wakefield. It is the custom for Members of Parliament to nominate or vote for the offices held by M.P.s, while the scientific organisations alone recommend representatives of scientific bodies.

OVERSEAS

Pyridine Substitution

A patent recently granted to the Hercules Powder Company of America describes a process for producing pyridine or substituted pyridines in the vapour phase. The method is based on the reaction between a conjugated diolefine and an alkyl cyanide in the presence of an aluminium oxide catalyst.

New Anti-Malarial Adopted

The U.S. Army, after three years of investigation, has officially adopted primaquine as a standard preventive against malaria. The drug, it is reported, is not expected to replace chloroquine, the drug at present used by the U.S. Army against malaria. Eli Lilly & Co. are sole manufacturers up-to-date, but the U.S. Government has a patent pending for a new manufacturing process.

Indian Ammonium Sulphate

The Sindhri factory, near New Delhi, for the production of fertilisers, worth £160,000,000, has just gone into production, it is reported. This is the first big state-owned enterprise to be launched in India since independence was granted. The factory is estimated to have an annual output of 35,000 tons of ammonium sulphate with gypsum as the starting material.

Sportsmen First?

An indication, perhaps, that chemical engineers and chemists are hard to come by in America is the range of advertisement that Du Pont is putting out for technicians to man its atomic energy project at Augusta, Georgia. These occupy space as far afield as New York State. They are not, however, on the 'Situation Wanted' page, but on the *Sports* page.

Methanol to Ethanol

A successful transformation of methanol to ethanol is reported from the U.S. Bureau of Mines. The process consists of heating proportions of methanol, cobalt carbonyl and synthesis gas to a temperature of about 185°C. under an average pressure of 3,500 p.s.i. Analysis by mass spectrometer is reported to show a conversion of 76.4 per cent of the methanol.

Agricultural Congress

The 9th International Congress of Agricultural Industries is to be held in Rome, Italy, from 23 to 31 May. The congress will be divided into about 40 sections.

Delaney Committee at Work

The Delaney Committee of Congressmen touring America in its investigations visited Washington recently to learn about a U.S. Public Health Service project there to determine the effect of DDT on human fat and of organophosphorus compounds on blood enzymes.

Curium Separated from Americium

Research workers at the University of California have recently completed the first isolation of curium (At. No. 96) from neutron-irradiated americium (At. No. 95). The elements were separated with a Dowex-50 ion-exchange resin. The curium was isolated as the fluoride and hydroxide.

New Vitamin B₁₂ Process

Two research workers from the U.S. Department of Agriculture have applied for a patent for a new process for producing Vitamin B₁₂, it is reported. In the process, propionic bacteria ferment mashes containing skim milk or whey. Experimental yields so far compare favourably with existing processes, and propionic acid appears as a by-product.

New Vitamin B₁₂ Process

As a result of expanded production facilities to meet steadily rising demands for Kel-F, a fluorocarbon-type thermoplastic, the price of this strategic material has been reduced more than 10 per cent as from 1 January, 1952, it has been announced by its manufacturer, The M. W. Kellogg Company, of New York City.

New prices for the low and high density moulding powders in ton lots will now be \$11 and \$12 a lb. respectively, a decrease in each case of \$1.30. Prices for plasticised moulding powders will also be reduced on an average of \$3 dollars a lb., as a result of lowering the cost of the plasticiser to \$12 a lb. In ton lots, this will mean a price of \$13 a lb.

Personal

The Chemical Division of Celanese Corporation of America announces the promotion of E. F. ELBIN to the position of district manager for the south-west territory. He will represent the Chemical Division's organic chemicals and organic phosphates departments in New Mexico, Texas, Oklahoma, Arkansas, Louisiana, Mississippi, Alabama and part of Florida. Mr. Elbin formerly lived in Cumberland, Maryland, and has been with the corporation since 1935.

MR. T. J. GARNER, export sales manager of Evans Medical Supplies, Ltd., Speke, Liverpool, has left England on a tour of India, Pakistan, Ceylon and the Far East. He will be away for about three months.

With effect from 1 January, Mr. K. R. GREEN has been appointed sales manager, Scientific and Industrial Products, of Sunvic Controls, Ltd. Educated at Westminster City School and Borough Polytechnic, Mr. Green commenced his early training with W. T. Henley's Telegraph Works Co., Ltd., and entered the field of scientific and industrial instrumentation when he joined the Cambridge Instrument Company in 1934, later joining Marconi-Ekco Instrument Company soon after its formation. During, and after the war, he was superintendent of the Engineering Division of Parkinson & Cowan, Ltd. He joined Sunvic Controls, Ltd., early in 1951 as an application engineer.

Evans Medical Supplies, Ltd., Speke, Liverpool, announces that it has co-ordinated the work of the departments concerned with pharmaceutical research, development and analytical control of pharmaceutical products in a Pharmaceutical Research and Development Unit, under the control of the pharmaceutical development director, Mr. C. W. ROBINSON. Managerial responsibility for the unit has been entrusted to Mr. F. A. J. TALMAN. The following new appointments have also been made: Mr. R. C. WHITEHOUSE, head of development department; Mr. R. WHITTAKER, pharmaceutical research; Mr. G. TUNSTALL, senior analyst; Mr. W. M. STRONACH, development department.

Obituary

Tribute to the late MR. C. J. T. MACKIE, assistant secretary of the Institution of Chemical Engineers and Chemical Engineering Group, Society of Chemical Industry, was paid by Sir Harold Hartley, president of the institution at its meeting on 8 January. Sir Harold said:

'You know that Mr. Mackie has been ill for some time. He took a month off before the end of the year to get a complete rest. I had a letter from him just before Christmas to say how anxious he was to get back to work. He came back recently to the office with that determination to get on with the job which always marked him, and you will be very sorry to hear that he died suddenly to-day.'

'Mr. Mackie has been assistant secretary since 1924. For 26 years he carried the whole brunt of the administration and financial work of the institution. He saw it grow from a small body to the one which we know to-day, and until Dr. Brennan joined us in 1950 he was in charge of the office and did the whole of our work; he devoted his whole life-effort to the institution. It was only his pluck which has kept him going during these recent years, when he really ought to have been taking things much more easily.'

'It is impossible to over-estimate what the institution owes to Mr. Mackie for his work during those years when it was growing, for his skilful administration and his wholehearted devotion to his work.'

The death of MR. RAYMOND C. GAUGLER, the president of American Cyanamid Company, took place in New York on 11 January. Born in Pittsburgh, Pa., 59 years ago, Mr. Gaugler received his education at parochial schools in that city and at Duquesne University.

Before joining the Cyanamid organisation in 1917 he was with The United States Aluminium Company in New Kensington, Pa., and the Northern Aluminium Company, Shawinigan Falls, Canada. Mr. Gaugler became a director of Cyanamid in 1929 and in 1939 he became vice-president in charge of finance and in 1947 executive vice-president.

Publications & Announcements

PHENOMENAL progress of the development of the production of chemicals from petroleum and the widening range of new synthetic materials resulting from this new industry are described in an article entitled 'Quiet Revolution' in the current issue of 'The Lamp' (Vol. 33, No. 3), published by the Standard Oil Company (New Jersey), U.S.A. Another article 'Up from the Ashes' tells how a major refining industry is rising from the war-devastated countries of Europe to meet her expanding demand for oil.

* * *

JOURNAL of the Scientific Research Institute of Japan (formerly the Scientific Papers of the Institute of Physical and Chemical Research) publishes five more treatises in its issue of October, 1951, obtainable from the Institute at Komagome, Bunkyo-ku, Tokyo. They describe a new method for preparing unsymmetrical cyanine dyes, the extraction of streptomycin and dihydrostreptomycin with phenols, and new syntheses for hydroxy-droserone, phthiocol (the human tubercle bacillus pigment) and naphthopurpurin, as well as studies of related compounds.

* * *

COPIES of the papers read at the 70th Annual General Meeting of the SCI are now available in book form from the Society at 56 Victoria Street, S.W.1 (15s.). The subject of the meeting was 'Water in Industry', and the reprinted booklet includes the introduction by H. W. Cremer, C.B.E., M.Sc., F.R.I.C., M.I.Chem.E., president of the RIC, given at the meeting. Papers include 'Availability of Water Supplies for the Chemical Industry in Great Britain' by Professor P. G. H. Boswell, 'Water and Crop Production', by Dr. E. W. Russell, M.A., 'The Soilless Cultivation of Plants' and others.

* * *

THE INSTITUTE of Fuel has published a complete list of all its councils and committees, extracts from Royal Charter and by-laws, the Institute's publications and education scheme, all the papers published by the Journal of the Institute from 1926-51, and a full list of members as at April, 1951. The Institute of Fuel was founded on 6 July, 1927, and incorporated by Royal Charter on 12 August, 1946.

A MERCURY vapour detector for indicating the amount of mercury vapour in an enclosed atmosphere either continuously or at intervals is one of the latest products of Hanovia, Ltd., of Slough, Bucks. The principle employed is the absorption by mercury vapour of ultra-violet rays at a wavelength of 2,537 Å. A low-pressure mercury resonance lamp is mounted at one end of a cylindrical chamber, and the intensity of its radiation is recorded on a photocell at the other. With clean air present the intensity is maximum. Any admixture of mercury vapour reduces ultra-violet transmission along the cylinder, and the micro-ammeter dial reads positive values for quantities of mercury vapour in two ranges, 0-1,400 µg./cu.m. and 0-100 µg./cu.m. 100 µg./cu.m. has been accepted by the Medical Research Council as the danger threshold to health.

* * *

THE Ministry of Labour and National Service (Factory Department) has issued a pamphlet on the prevention of the propagation of flame in aluminium dust explosions (HMSO, 1s. 3d.). It contains an account of some *ad hoc* experiments on aluminium dust explosions in a narrow duct carried out by H.M. Inspector of Factories, and deals with the physical phenomena of dust explosions, experimental plant and the results of the experiments. Vivid photographs show the propagation and suppression of flame during the experiments.

* * *

MACHINE components coming into contact with chlorine gas cannot be lubricated with oil because the latter is chemically affected by the gas and loses its lubricating properties. In the past there was no alternative but to replace the oil in chlorine gas compressors by concentrated sulphuric acid or some similar substance. A non-lubricated compressor for handling chlorine gas is described in an article on 'New Designs of Oil-free Compressors', in the *Sulzer Technical Review* (No. 2, 1951). Another article, based on the experience acquired by Sulzer Brothers in the employment of steel plate for the construction of high-pressure pipe lines, describes recent progress in the development of high-strength structural steels and welding methods.

A REVIEW published by Murex, Ltd. (Volume 1, No. 9) contains two papers. One is on the electrodeposition of molybdenum and its alloys, by F. W. Salt, Ph.D., which covers the elements and its alloys with cobalt, nickel and iron, and the other is on the creep of metals and creep-resistant alloys, by A. H. Sully, M.Sc., Ph.D., F.Inst.P., F.I.M. The review contains many illustrative photographs. A section at the end reprints from *Chemical Abstracts* a number of abstracts concerned with metallurgy. The review is obtainable on application to Murex, Ltd., Rainham, Essex.

* * *

A CONTROL system for steam plants embodying the experience of two firms noted in their respective fields of instrumentation and automatic boiler control is announced by Elliott Brothers (London), Ltd., and James Gordon & Co., Ltd., of Stanmore, Middlesex. The Elliott-Hagan system is available from both companies, the sales and technical department of which will be pleased to assist the user, consultant and contractor with their joint experience. Specialist staffs and manufacturing resources enable them to design, supply and commission complete installations for all types of steam plant.

* * *

TESTING of milk, milk products and ice cream is an exacting science and Government regulations have imposed an obligation on producers to maintain these tests at frequent stages; this has provided an impetus to research, but much still remains to be done. To assist those engaged in research or whose duty it is to carry out the day-to-day routine tests W. & J. George & Becker, Ltd., have now issued a specialised catalogue to replace the original list published when the 1942 schedule of apparatus was the acknowledged standard. The new catalogue deals with apparatus for plate count, direct microscopic count, coliform, methylene blue and resazurin tests, keeping quality, phosphatase test, examination of water supplies, testing for fat and solids not fat, visible dirt in milk, estimation of fat in cheese, and sampling requisites. It is pointed out that in this type of catalogue there must be a number of omissions because of its specialist nature. Many auxiliary items are, of course, covered by the company's catalogue of chemical laboratory apparatus already widely distributed.

A HANDSOME booklet on titanium pigments has recently been published by National Titanium Pigments, Ltd., a subsidiary of Laporte Chemicals, Ltd. It describes the manufacturing process of the pigments from ilmenite ore down to the two types of commercial pigment available—'anatase type' and 'rutile type', incorporating two of the three allotropes of titanium dioxide. These are called 'Tiona' and 'Runa' respectively. X-ray diffraction gives production control of 'Runa', of which there is only one grade at present, the 'Tiona' range including eight grades. 'Tocarba' pigment, also marketed by the company, is another pigment, incorporating titanium dioxide in the anatase form, and barium carbonate and sulphate.

* * *

APPLICATIONS of 'Sorbit' (sodium alkyl naphthalene sulphonate) over a wide range including detergents, disinfectants, textiles, metal processing, polymerisation, and as an addition to water for fire control, are described in a new bulletin, obtainable on request, from the Alrore Chemical Company, Providence 1, Rhode Island, U.S.A. Specifications, biological properties, solubilisation, emulsification and wetting action of 'Sorbit' are also given in the bulletin.

* * *

FIRE hazard associated with fuelling aircraft in the open air is the subject of a newly published pamphlet by HMSO. The first of a series of technical papers initiated by DSIR and Fire Officers' Committee, it deals mathematically with what is at best an approximate subject. This is the first time that anyone has attempted to define the fire hazard associated with fuelling aircraft, although there has been research on fires in flight and on fires after crash-landings. In experiments, the research workers measured the vapour concentrations of fuel at varying distances from the point of filling. Air in a petrol tank before filling is saturated with petrol vapour and contains at ordinary temperatures about 28 per cent petrol vapour—well above both lower and upper combustion limits (1.3 and 6 per cent). On dilution, therefore, it must pass through the critical explosive range and the nature of the explosive region is determined by wind, meteorological conditions and rate of filling. The danger area can extend for anything from a few inches up to 25 yards.

Important announcement

Permutit **MIXED BED "DEMINROLIT"** Plants for treating any quantity of water are now available for industrial needs.

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Law & Company News

Commercial Intelligence

The following are taken from the printed reports, but are not responsible for errors that may occur.

Mortgages and Charges

(Note.—The Companies Consolidation Act of 1908 provides that every Mortgage or Charge, as described herein, shall be registered within 21 days after its creation, otherwise it shall be void against the liquidator and any creditor. The Act also provides that every company shall, in making its Annual Summary, specify the total amount of debt due from the company in respect of all Mortgages or Charges. The following Mortgages or Charges have been so registered. In each case the total debt, as specified in the last available Annual Summary, is also given—marked with an *—followed by the date of the Summary, but such total may have been reduced.)

ANGLO-DUTCH PETROLEUM CO., LTD., London, N.W. (M., 19/1/52). 10 December, mortgage, to West London Permanent Mutual Benefit Building Society, securing £6,780 and further advances; charged on Roundabout Garage, Bath Road, Harmondsworth. *Nil. 2 October, 1950.

BALDWIN INSTRUMENT CO., LTD., London, W., scientific instrument manufacturers, etc. (M., 19/1/52). 4 December, first debenture, to Westminster Bank, Ltd., securing all moneys due or to become due to the bank; charged on lands and workshops, etc., thereon at Stone (nr. Dartford); also a general charge. *Nil. 12 April, 1951.

BRITISH ALUMINIUM CO., LTD., London, S.W. (M., 19/1/52). 10 December, disposition by Mrs. Georgina Purves or Woodburn, with consent granted in implement of a Trust Deed dated July 30, 1947, supplemental to a Trust Deed dated 10 November, 1948; charged on 18 Dickter, Burntisland, with fixtures and fittings. *£5,000,000. 15 May, 1951.

LEDA CHEMICALS, LTD., London, E.C. (M., 19/1/52). 4 December, mortgage, to Midland Bank, Ltd., securing all moneys due or to become due to the bank; charged on land at Waltham Cross, with machinery, fixtures, etc.; also a general charge. *£2,100. 28 December, 1950.

Satisfaction

LONDON ALUMINIUM CO., LTD., Birmingham. (M.S., 19/1/52). Satisfactions 7 December, that properties (285 Rocky Lane, Perry Barr and Crown Works, Fazeley Street, Birmingham) comprised in a mortgage and charge registered 13 December, 1949, have been released from the charge.

Company News

Anglo-Ferralyt Co., Ltd.

Private company. (502,964). Capital £100. Manufacturers of all kinds of chemical and other materials and compounds; and manufacturers of sulphur from hydrocarbons or other similar substances, etc. Directors: P. Willert A. Blank and M. O'Brien. Solicitors: Withers & Co., 4 Arundel Street, W.C.2.

Ardeen Products (Manchester), Ltd.

Private company. (502,334). Capital £500. Chemical, dye and colour manufacturers, drysalts, etc. Subscribers (each with one share) are: M. D. Chantler and D. Maskrey. Solicitors: Brett, Ackerley & Cooke, 24 Kennedy Street, Manchester.

Biosun, Ltd.

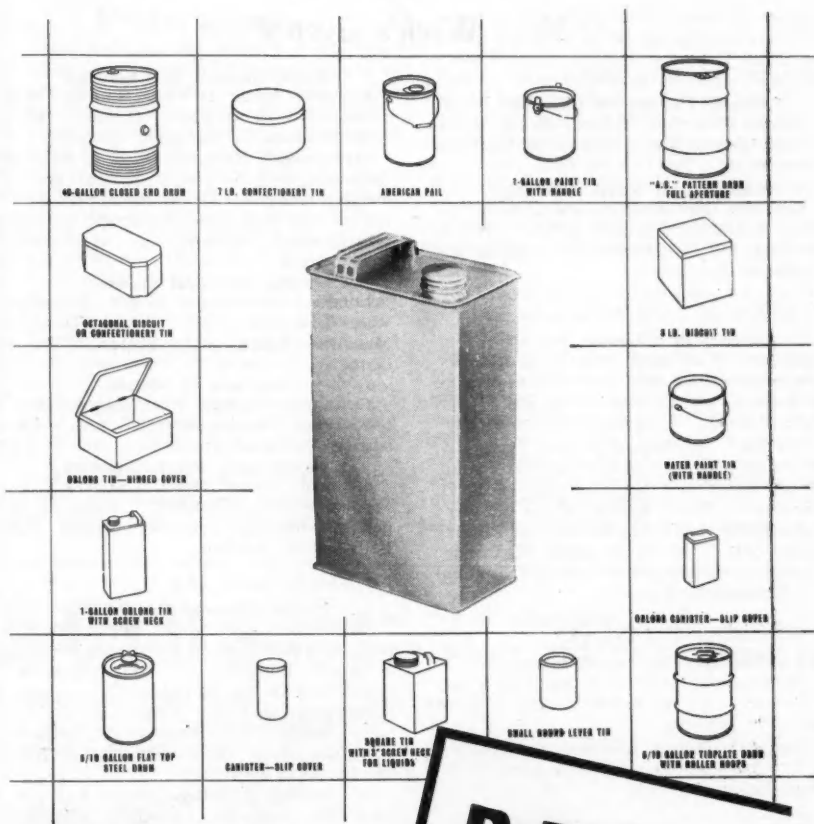
Private company. (502,503). Capital £2,000. Manufacturing, research, analytical chemists and druggists, etc. Directors: W. S. Wood and A. S. Service. Reg. office: 113 School Road, Ashford, Middlesex.

Defur Descaling Services, Ltd.

Private company. (502,834). Capital £1,500. Chemical and mechanical descalers, cleaners and repairers of boilers, etc. Directors: T. H. Piper, J. A. Carver and G. R. Wyatt. Reg. office: 2 St. Marychurch Street, Rotherhithe, S.E.16.

Bowmans Chemicals, Ltd.

The serious effect of the reduction in its allocation of sulphuric acid was referred to by Mr. S. N. W. Pert, chairman of Bowmans Chemicals, Ltd., in his report for the year ended 31 October, 1951. For the first eight months the company was unable to meet the demand for its products and practically all export orders had to be turned down. For the last four months, due to purchasing imported sulphuric acid at an exorbitant price, there had been some improvement in output. Export trade had, however, declined, and for the present showed no signs of improving. Trading profits for the year were a record and the directors recommended a final dividend of 7½ per cent (less tax) on ordinary shares, making (with the interim dividend of 5 per cent paid in July) a total of 12½ per cent.



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Next Week's Events

MONDAY 21 JANUARY

Royal Institute of Chemistry

Leeds: University, 6 p.m. Dr. E. R. H. Jones: 'Recent Developments in Acetylene Chemistry'.

Institute of Metal Finishing

London: Northampton Polytechnic, St. John Street, Clerkenwell, E.C.1. W. A. Marshall: 'Non-Electrolytic Smoothing Treatment for Steel'.

TUESDAY 22 JANUARY

Society of Chemical Industry

Exeter: Washington Singer Laboratories, Prince of Wales Road, 5 p.m. Joint meeting with the Chemical Society and RIC. Dr. F. H. Pollard: 'Inorganic Chromatography'.

London: Burlington House, Piccadilly, W.1, 6.30 p.m. Plastics and Polymer Group. 'New Materials', H. R. Wright and H. Zentman: 'Phenyl Resins'; R. N. Wheeler: 'Chemistry and Application of Epoxy Resins'; J. G. N. Drewi and J. N. Fisher: 'Synthetic Condensation Polymers Containing Heterocyclic Rings'.

WEDNESDAY 23 JANUARY

Society of Chemical Industry

Birmingham: University, Edmund Street, 6.30 p.m. J. A. Radley: 'The Use of Starch in Industry'.

London: Burlington House, Piccadilly, W.1, 6.30 p.m. Dr. H. Wilkinson: 'The Digestibility of Fats'.

THURSDAY 24 JANUARY

Society of Chemical Industry

Bristol: University, Woodland Road, 7 p.m. Joint meeting with the Chemical Society and RIC. Lecture and demonstration by W. Edwards & Co. (London), Ltd.: 'High Vacuum in the Service of the Chemist'.

Liverpool: University, 4.30 p.m. Joint meeting with the Chemical Society, RIC and BAC. Dr. A. Neuberger: 'Some Recent Advances in the Chemistry and Biochemistry of Porphyrins'.

London: Imperial College, S.W.7, 2.30 p.m. Agriculture Group. Professor G. E. Blackman (Sibthorpe Professor of Rural Economy, Oxford University): 'Oil Seed Crops in Temperate Climates'.

Royal Institute of Chemistry

London: Acton Technical College, High Street, W.3, 7.30 p.m. C. G. S. Hill: 'Luminescence in Inorganic Chemistry'.

Manchester: Reynolds Hall, College of Technology, 6.15 p.m. Annual general meeting, 6.45 p.m. Dr. M. Barak: (Chloride Electrical Storage, Ltd.), chairman's address: 'Fundamental Problems in Accumulator Manufacture'.

The Chemical Society

London: Burlington House, Piccadilly, W.1, 7.30 p.m. The 'Gustav Tamann' Memorial Lecture, by Professor W. E. Garner.

Institute of Metals

Birmingham: James Watt Memorial Institute, Great Charles Street, 7 p.m. Discussion: 'Productivity'.

Incorporated Plant Engineers

Sheffield: Grand Hotel, 7.30 p.m. 'Fuel Problems—Any Questions?' Panel of experts comprising Professor Sarjant, Dr. Fells and F. Southern.

FRIDAY 25 JANUARY

The Chemical Society

Birmingham: University, Edgbaston, 4.30 p.m., with Birmingham University Chemical Society. Professor R. D. Haworth: 'Chemistry of the Tropolones'.

Newcastle-on-Tyne: King's College, 5.30 p.m. Bedson Club Lecture. Professor C. A. Coulson: 'The Contribution of Wave Mechanics to Chemistry'.

St. Andrews: United College, 5.15 p.m., with St. Andrews University Chemical Society. Professor R. G. W. Norrish: 'New Approaches to the Study of Combustion'.

Institute of Metal Finishing

Sheffield: Grand Hotel. J. S. Bowden: 'Tin-Zinc Deposition'.

SATURDAY 26 JANUARY

Institution of Chemical Engineers

Birmingham: University, Edmund Street, 3 p.m. Midlands Branch, annual general meeting. D. F. Kelsall: 'Preliminary Study of the Motion of Solid Particles in a Hydraulic Cyclone'.

Society of Public Analysts

Manchester: Engineers' Club, Albert Square, 2 p.m. 27th annual general meeting. A. L. Bacharach: 'The Use of Laboratory Animals as Analytical Reagents'.

Market Reports

LONDON.—There has been a steady demand in the home market for most of the routine industrial chemicals and the volume of new inquiry has returned to fair-sized dimensions. Export trade was maintained at recent levels. In all sections price conditions were strong with a firm undertone. The non-ferrous metal compounds were in good request with ground-in-oil Red and White Leads having a ready outlet at the higher rates now ruling. Demand for borax, boric acid, bleaching powder and arsenic was active while the movement of the soda and potash compounds was about the average for the period. Interest in fertilisers increased with the approach of seasonal demand. Firm conditions have been reported during the past week for the coal tar products and in most sections of the market an active demand was expected to be maintained.

MANCHESTER.—From the point of view of inquiries and of actual new business fairly active trading conditions have been experi-

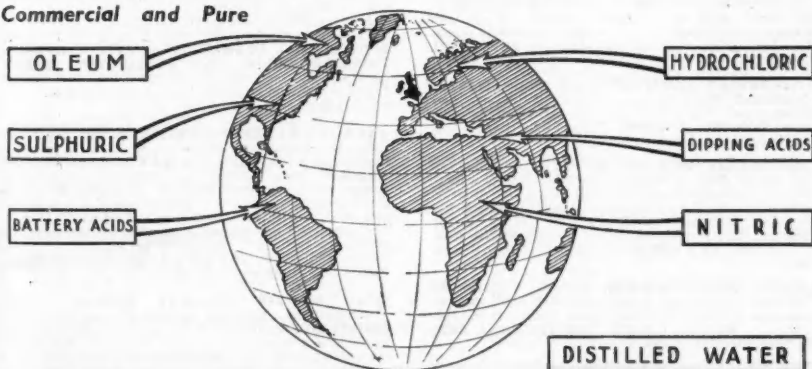
enced on the Manchester chemical market during the past week, though the call for textile chemicals has not been so brisk as it was a short time ago. Existing contracts for the alkali products and most other compounds are being steadily drawn against by home industrial users and the export movement has been satisfactorily maintained. With regard to the fertilisers, buying interest is showing a gradual improvement and the phosphatic materials have shared in this. A good demand for most of the tar products continues.

GLASGOW.—Trade is beginning to pick up after the seasonal lull and a good demand is being enjoyed by all sections of the trade. There have been no outstanding features and it is somewhat early yet to forecast as to whether or not the demand is likely to be maintained. The easing in supplies of acetone has come as a welcome relief to many manufacturers and generally speaking there is not much change in the overall position. With regard to export, demand is following normal channels.

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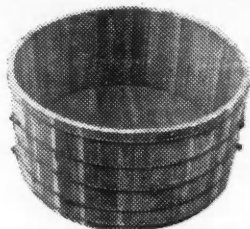
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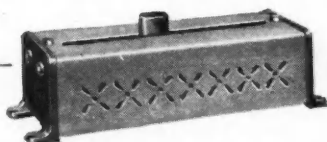
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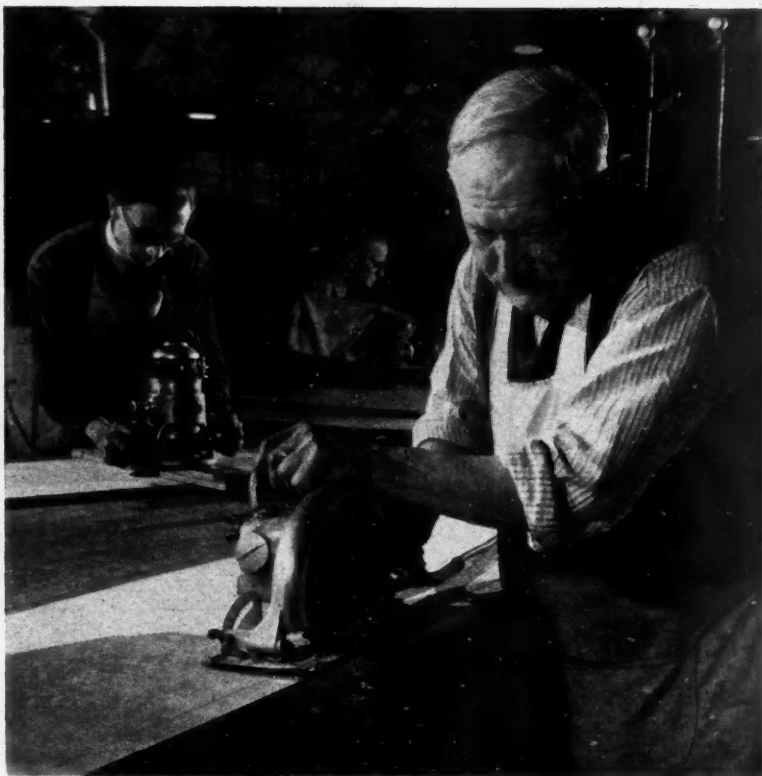
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Trimming and finishing plywood with electrically powered hand tools at Thames Plywood Manufacturers Limited

More power to his elbow

GREATER PRODUCTIVITY means more output from each worker, but there is a limit to what a pair of hands can do unaided. Put power into them and there is a different story to tell. Electrically powered hand tools—saws, drills, sanders, grinders and the rest—can multiply many times the output of the worker who uses them. Easy to use, instantly plugged in wherever they are needed, they *save time and toil, and make the most efficient use of the available power supply.*

WHERE TO GET MORE INFORMATION
Your Electricity Board will be glad to help you to get the utmost value from the available power supply. They can advise you on ways to increase production by using Electricity to greater advantage—on methods which may save time and money, materials and coal, and help to reduce load shedding. Ask your Electricity Board for advice: it is at your disposal at any time.

Electricity for **PRODUCTIVITY**

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